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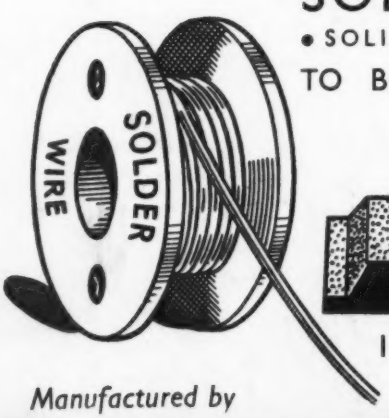

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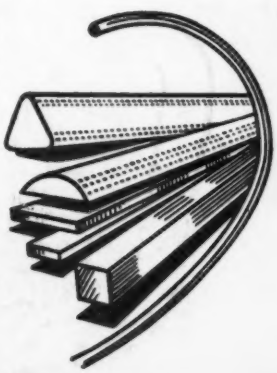

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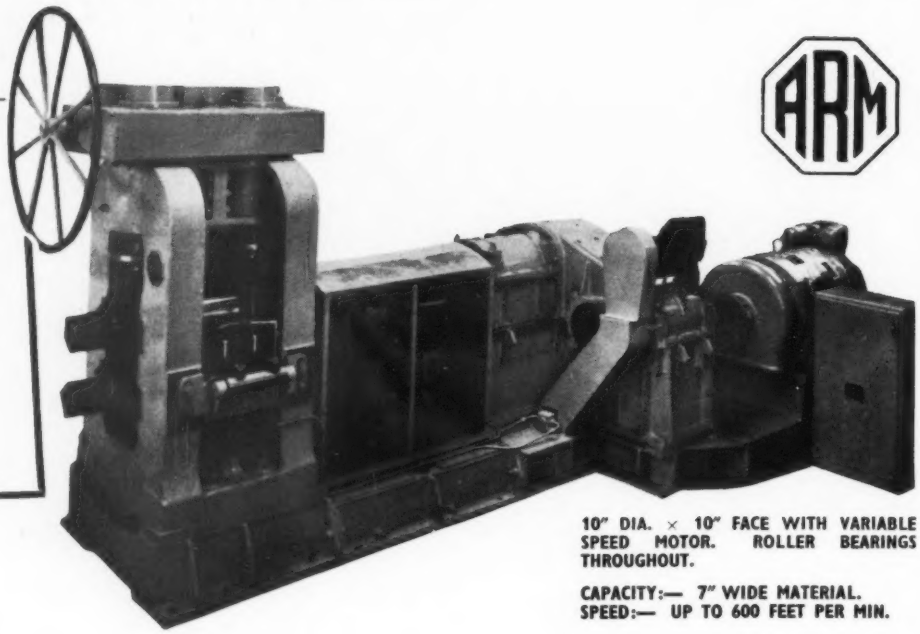

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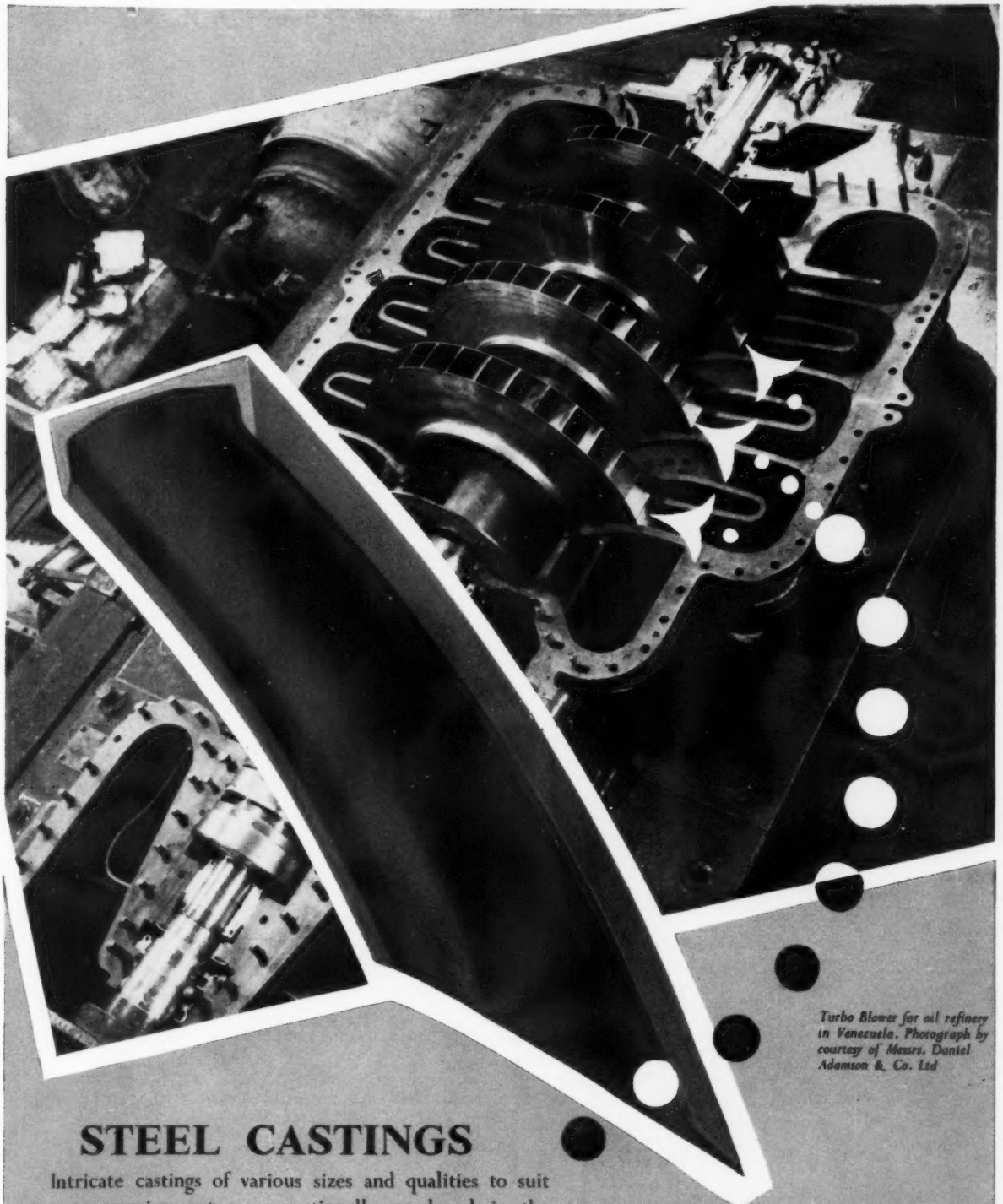

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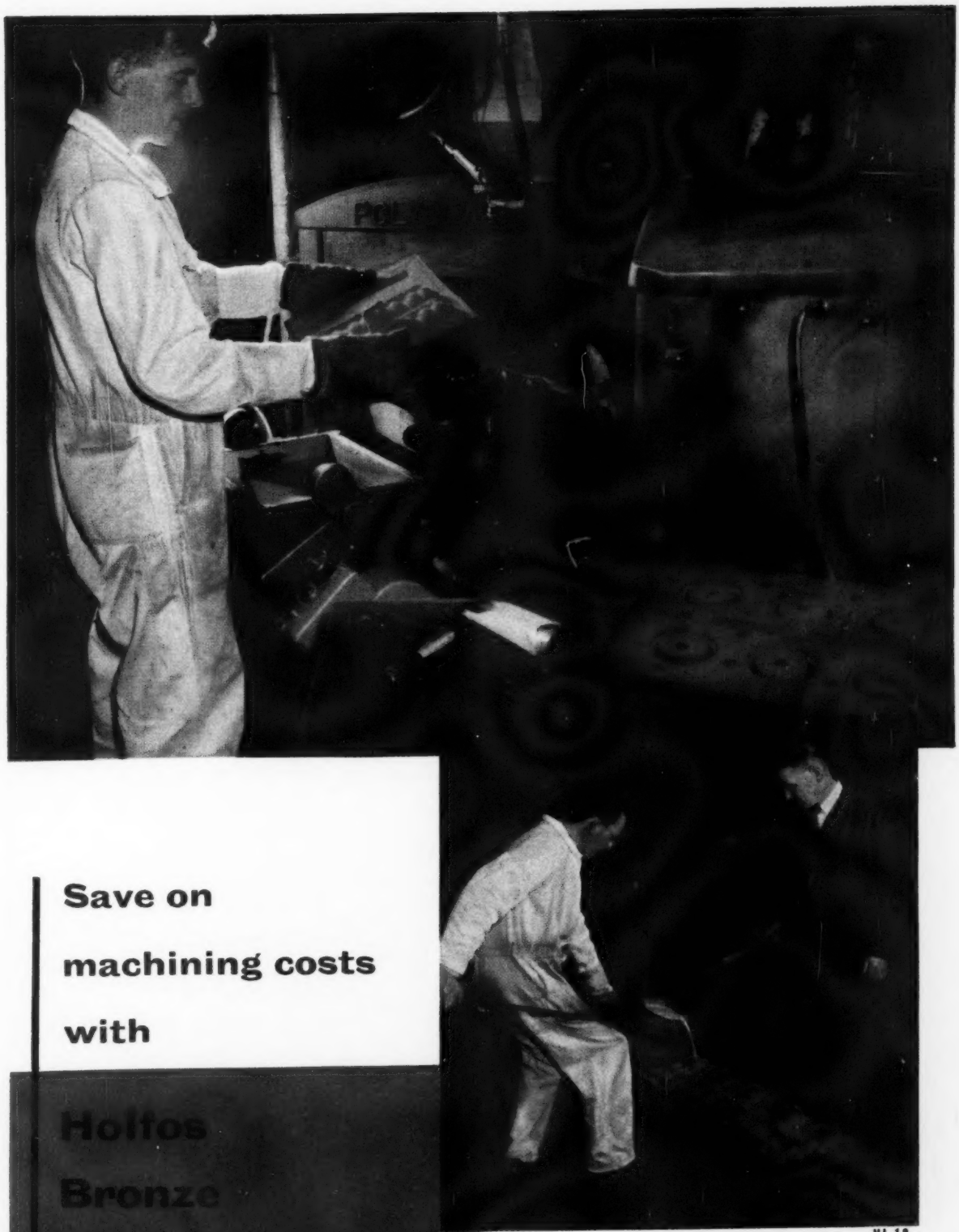

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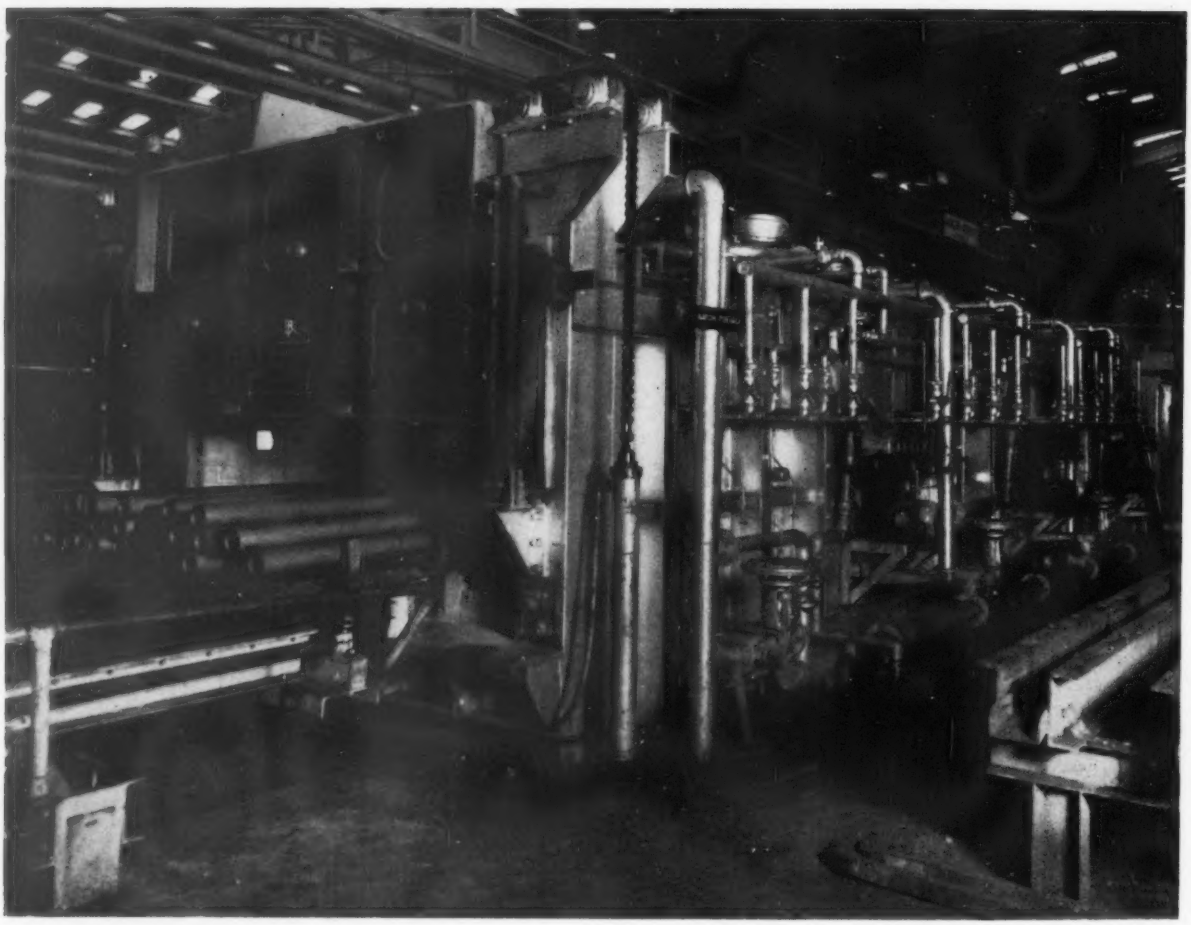

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Batch Type Annealing Furnace, Town's Gas Fired. 8′ 0″ wide × 30′ 0″ long for non-ferrous tubes, operating temperatures 250°-800°C. Output 3 Tons per hour. Automatic proportioning gas burners give atmosphere control with uniformity of temperature and economy in operation.

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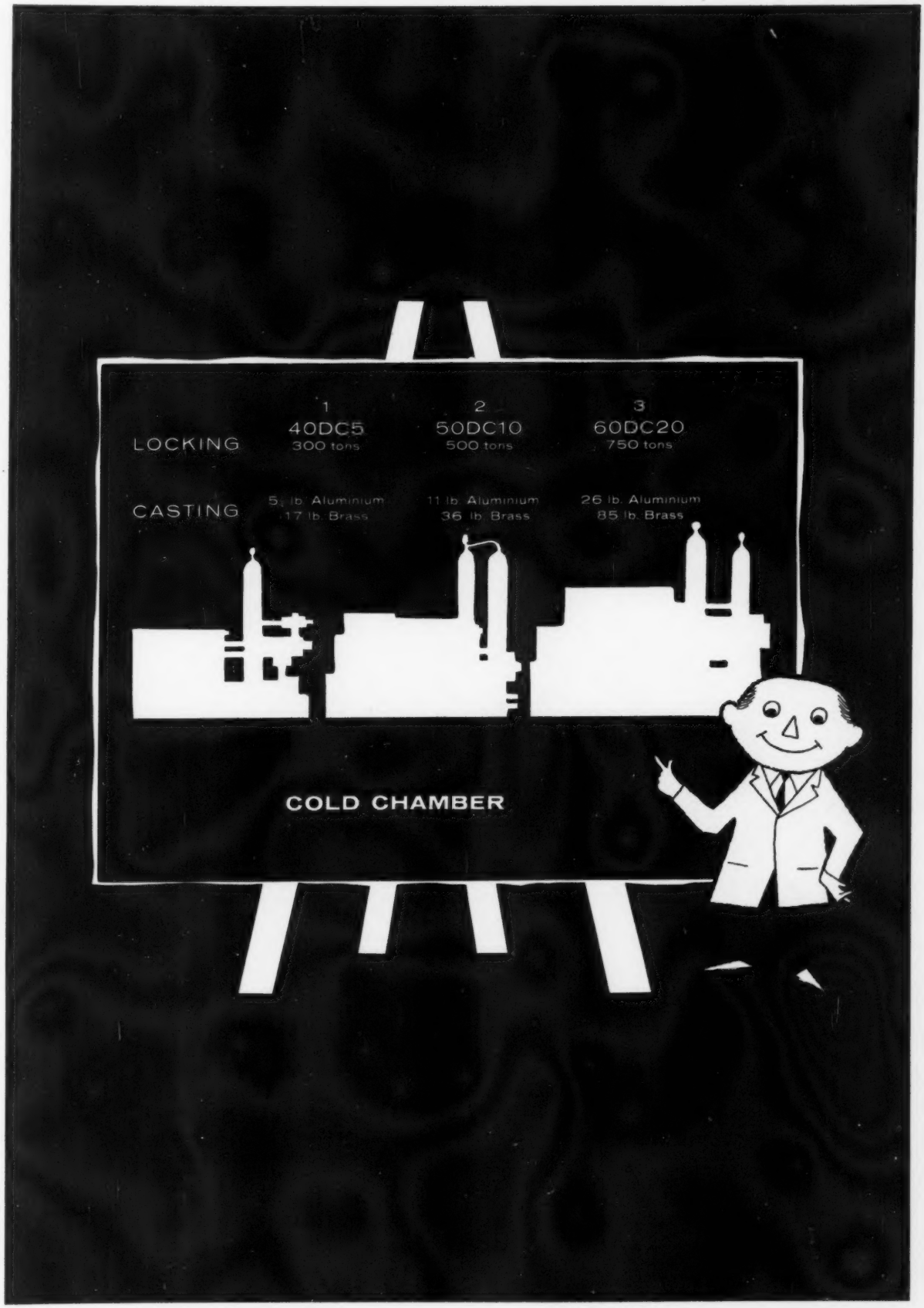
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Electrical Aids in Industry *Data Sheet* **No. 4**

Resistance Heating-1

In this form of heating, the heat is produced by passing an electric current through a high resistance conductor which is termed the " heating element ".

The heat is transferred from the heating element to the work by convection, radiation or conduction, or by a combination of any, or all of these. When it is a question of radiation or convection, the element can be a bare wire or strip of suitable material, provided it is adequately supported on electrical insulation capable of withstanding the temperature.

When there is to be contact between the work and the element, heat being transferred to the work by conduction, the wire or strip must be surrounded by suitable insulating material and enclosed in a protective sheath.

In the majority of cases, the wire or strip forming the heating element is made of a nickel-chromium alloy which has a high electrical resistance and can be safely used in air at temperatures of up to 1050°C., or in a suitable atmosphere, of up to 1150°C. Other element materials are available for use at higher temperatures.

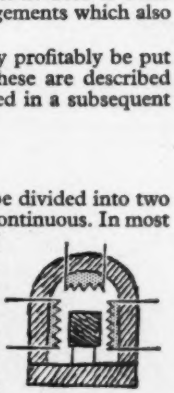
Sheathed elements, essential for contact heating but also used widely for convection and radiation heating because of the convenience afforded by the mechanical strength of the sheath, usually metallic, and by their "built-in" electrical insulation, cannot be used at temperatures as high as the bare wire or strip. This is because the wire, being embedded in insulation, is always at a higher temperature than the sheath, and to keep the wire temperature down to a safe figure the sheath temperature is usually limited to a maximum of around 800°C.

Automatic temperature control of resistance heating elements within narrow limits is easily effected, but if manual control only is desired, devices are available which enable the heat output of the elements to be controlled precisely at a required level. As with all electrical methods, a time switch may be included in the control circuit for automatically switching on or off at predetermined times, and this can enable, for example, an electric oven to be fully up to working temperature by the time the working day starts. Since there are no combustion products from the heaters, there is no need to build flues or special ventilating arrangements which also carry away useful heat.

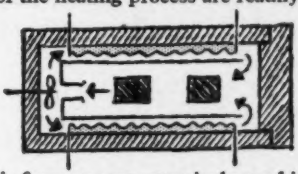
Electric resistance heating may profitably be put to many diverse uses; two of these are described briefly below, others will be listed in a subsequent data sheet.

Furnace Heating

Electric resistance furnaces can be divided into two main categories, batch type and continuous. In most cases, the heating elements are of nickel-chromium alloy, for furnace temperatures up to around 1050°C., but higher temperatures, up to nearly 3000°C., can be obtained by using other metals or alloys, or in some cases non-metallic elements. A protective atmosphere is desirable to prolong the life of some of these higher-temperature elements. For all temperatures, electric resistance furnaces can be constructed so that the heating process takes place in a controlled atmosphere if this is dictated by the composition or heat requirements of the work charge. In some furnaces, fans are used to circulate the air or special atmosphere over the charge, thereby giving increased heating rates and a uniform temperature over the whole charge.



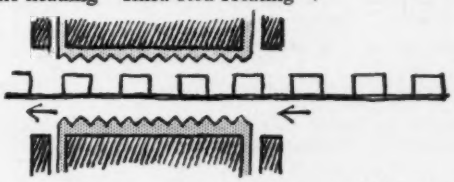
Automatic temperature control and programme control of the heating process are readily effected.



Electric furnaces are extensively used in industry, for example in the general heat treatment of metals, in the glass and ceramics industries, for brazing and sintering, and for many other applications requiring temperatures above 500°C.

Oven Heating

There are two basic forms of heat transfer used in electric resistance ovens: convection and radiation. The latter is dealt with in a separate data sheet under the heading " Infra-Red Heating ".



Convection ovens may again be of the batch or continuous type. In either case, the charge is heated mainly by the movement of hot air, which is sometimes assisted, as in furnaces, by fans to give a rapid and uniform temperature rise. Ovens are normally designed for temperatures of up to about 500°C., and the heating elements are invariably of nickel-chromium or nickel-chromium-iron alloy.

Ventilation, when required, can be provided and regulated entirely to suit the heating process. Temperatures and times are readily controlled. A vacuum can be maintained in suitably designed ovens to assist in the extraction of moisture and solvent.

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For further information, get in touch with your Electricity Board or write direct to the Electrical Development Association, 2 Savoy Hill, W.C.2.

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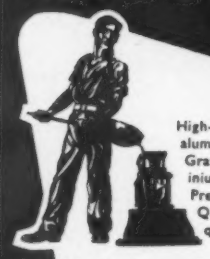

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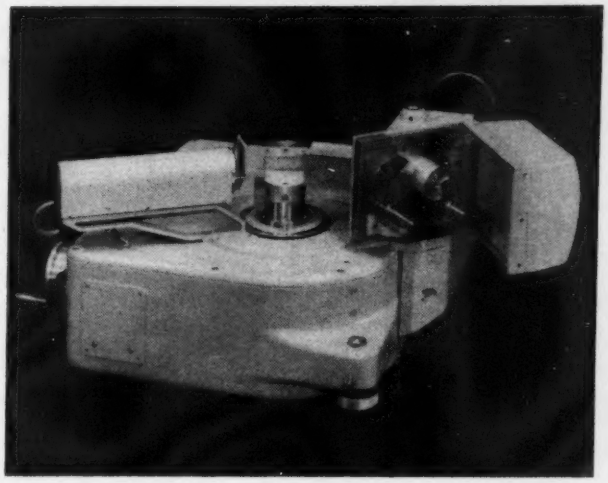

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The illustration shows a simple X-ray fluorescence spectrometer that is specially suitable for research and experimental work. On the right of the picture is the X-ray tube and sample-holder. Rays from the sample are reflected at various angles by the crystal seen in the centre of the picture, and detected by the detecting-head on the left.

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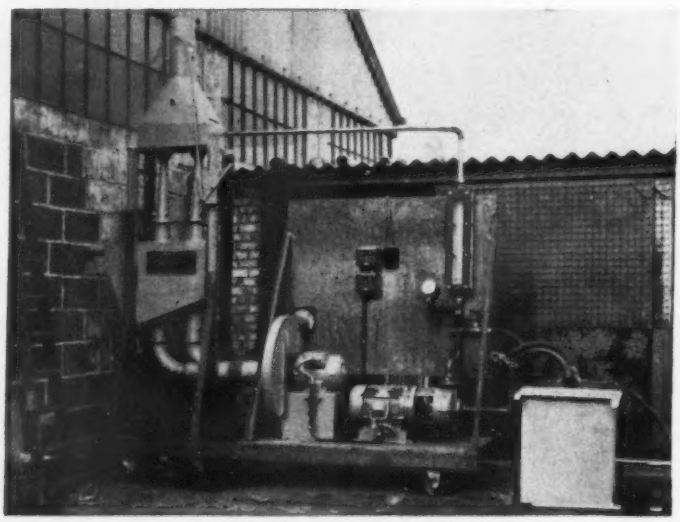

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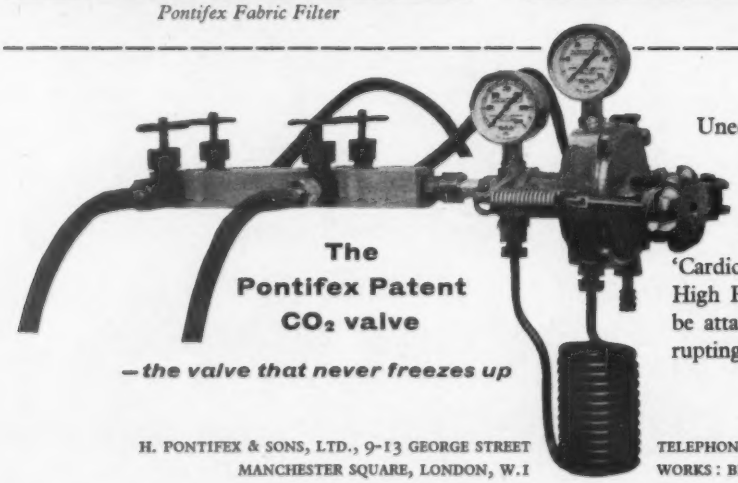

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FOUNDED 1909

EDITOR: L. G. BERESFORD, B.Sc., F.I.M

27 MARCH 1959 VOLUME 94 NUMBER 13

CONTENTS

	Page
Editorial: B.S.S. 1400	241
Out of the Melting Pot	242
Analysis of Zirconium and Zirconium Alloys. *By W. T. Elwell*	243
Men and Metals	246
Packaged Foundries	247
Pressure Die-Casting Review: Die-Cast Two-Speed Drill	251
Contract Heat-Treatment Service	253
Obituary	253
Industrial News	254
Metal Market News London Paris Birmingham New York	256
Non-Ferrous Metal Prices	257
Scrap Metal Prices	258
Foreign Scrap Prices	259
Metal Statistics	259
Financial News	259
Trade Publications	259
The Stock Exchange	260

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VOLUME 94 NUMBER 13 27 MARCH 1959

B.S.S. 1400

TO draw up a specification for copper alloy ingots and castings which will satisfy all the interests concerned is a task which might well have exhausted the patience of Job himself, and, indeed, may be said to be well-nigh impossible. There is, of course, no doubt that in the long run it is of benefit to the foundry industry as a whole that technical standards should be raised. At the same time it should be realized that there is no point in specifying finer limits for certain elements if the means of determining those elements to the necessary accuracy are not available.

As a case in point take the new proposed B.S.S. 1400 which requires a guarantee not only from the ingot supplier, *but also from the founder*, that aluminium shall not exceed 0·01 per cent, silicon 0·02 per cent and iron 0·25 per cent, as compared with the current specification which demands only a maximum total for these three elements together of 0·50 per cent.

There is little doubt that very small amounts of aluminium oxide can adversely affect the pressure tightness of gunmetal and bronze castings. Aluminium can readily be removed in refining by oxidation and the use of suitable fluxes but as there is no rapid method for the estimation of aluminium it has usually been sufficient evidence of aluminium removal if the ingot shows no trace of the white oxide skin, so characteristic of contamination by aluminium in excess of 0·02 per cent; in other words double the amount tolerated in the new specification. Furthermore, to the best of our knowledge not only is there no rapid control method for the estimation of aluminium, but also no reference methods of analysis are in existence. Similarly a control method for the estimation of silicon is not available. Lacking these analytical techniques it is difficult to see how the proposed standards can be guaranteed unless it is suggested that only virgin metals are to be used in the manufacture of the alloys. Even then there is the ever-present danger, when remelting, of picking up impurities in excess of the low limits proposed and this could preclude the use of scrap runners and risers.

Apart from the technical angle the problem is also one of economics. Although it may be possible to meet the technical requirements it can be done only at increased cost. For instance, at the present time the manufacture of ingots to B.S.S. LPB1 provides an economic use for materials which are too high in zinc to be conveniently used in the production of other phosphor bronzes and too high in phosphorus for the manufacture of gunmetals. The proposed lowering of the zinc limit in this alloy from 2 per cent to 1 per cent will increase the price of ingots by up to £20 per ton and would certainly make it more difficult to compete in export markets. This would obviously be reflected in increased prices on the home market and might open the way to the export of scrap to the detriment of home industry.

The current B.S.S. 1400 has been in use for a number of years and, in general, has proved very satisfactory. There does not seem to be a wide-spread desire that changes should be made. Since no definite scientific data on the optimum amounts of alloying elements and the effects of impurities are available, and since analytical techniques for their estimation are lacking, it would seem wiser not to proceed with the proposed revisions. There is no point in revising a specification unless it can be proved to be necessary and its requirements can be proved to have been met.

Out of the MELTING POT

Asking for More

ALUMINIUM has undoubtedly been the metal most favoured by the attentions of fundamental research in metal physics. No other metal has been used so frequently in studies of deformation, work hardening, recovery, recrystallization, age-hardening, and of the behaviour and interactions of the various types of lattice defects. In spite of this interest in the metal and the very large amount of information accumulated in the course of these investigations, the repercussions of all this work on the technology of aluminium have so far been insignificant. There have certainly been no triumphs comparable to those gained by research into the solid state in the field of semi-conductors, with its transistors, rectifiers, etc. Nevertheless it is appropriate that attempts should be made like the one recently undertaken by Dr. D. Altenpohl of the Aluminium-Walzwerke Singen, to indicate where the findings of research in metal physics are already in a position to provide explanations and some understanding of phenomena inexplicable in terms of the classical metallurgy of the inter-war years. Such phenomena include, for example, the formation of thermopits on the surface of single-crystal or coarse-grained aluminium on heating, the marked effect of very small amounts of copper on the recrystallization behaviour of aluminium, and the effect of additions of magnesium (0·1-3 per cent) in facilitating recovery at relatively low temperatures. Not content with the above, Dr. Altenpohl quite rightly goes on to suggest other phenomena for which explanations may be expected to be forthcoming from fundamental research in metal physics. Among such phenomena are the influence of magnesium on the age-hardening of aluminium-copper alloys, the stress-corrosion of aluminium-magnesium alloys, the sensitivity to intercrystalline corrosion brought about by certain alloying elements, the influence of impurities and alloying elements on texture, the properties of such materials as SAP, and the plastic deformation behaviour at various temperatures and at various rates of deformation. In connection with the latter, additional ground will now have to be covered by theory in order to catch up with the findings in regard to the behaviour of metals of the recent development of explosive forming methods.

Questionable

WITHOUT going all the way with that well-known definition of statistics that puts them at the end of an unenviable series, occasional users of statistical information can hardly avoid feeling a little disappointed if nothing else. Regular users are of course in a different position. The limitations and deficiencies of the information that is available will not, since they are accustomed to them, strike them as unfortunate. Above all, regular users will have the advantage of having had enough time to have succumbed to the spell of statistics as statistics, under which spell it is possible for apparent common sense to derive from statistics rather than criticism and rejection of some statistics to derive from common sense. This spell that statistics are able to exert seems to take effect as soon as statistics come into being. How otherwise is it possible to explain the attitude of all publishers of statistics to their products; the attitude that permits them for example, to switch happily from one basis to some entirely different one, rendering intercomparison impossible; the attitude that allows them to jump gaps, leaving them for others to fall into; the attitude of self-sufficiency that enables them to ignore the fact that there may be other statistics in the same field with which their own may or may not be comparable, let alone agree? Finally, there is the attitude that lets them continue their activities with apparently never a thought as to the questions that users of their statistics might ask in the hope of getting satisfactory answers. Regular users of statistics must be aware of this state of affairs and consequently of the questions it is reasonable or unreasonable to ask. Occasional users, who get the wrong answers or no answers at all, must blame their lack of experience in this respect. At the same time, however, they are also in the more fortunate position of not having fallen under the spell of statistics and therefore are still able to ask whether this state of affairs is inevitable. It may be, of course, that this question is also one of those it is unreasonable to expect statistics, or in this case those concerned with them, to answer.

Right Away

IT is now beginning to look as if the "boat" of the use of ultrasonic vibrations in particular, or mechanical vibrations in general, in the plastic working of metals is likely to sail at any moment. Anybody who is likely to be sorry to have missed it should therefore start to see how he could get on without delay. So far as this page is concerned, the subject was broached by the query as to what could be the effect of using ultrasonics to vibrate extrusion and drawing dies (this page, METAL INDUSTRY, 23 January, 1959, p. 62). Next, attention was drawn to a news item claiming that "extrusion of metal by ultrasonic energy is in the early developmental stage" and that the "rate of extrusion can be increased, or force for given extrusion rate can be reduced." (This page, METAL INDUSTRY, 13 March, 1959, p. 202.) The next step is to note a recently published account of an investigation into the plasticity of metal single-crystals in an ultrasonic field. The work, carried out at the University of Vienna, showed that, in tensile tests, the shearing stress required to maintain slip is reduced to a considerable extent by the application of ultrasonic vibrations. The drop occurs immediately on applying the ultrasonics. After the latter have been discontinued, strain hardening increases rapidly, finally reaching the value obtaining before the application of the ultrasonic vibrations. The effect of the latter is explained in terms of their activating effect on anchored dislocations. The next step is to note some recently-published Russian work on vibrational loading in the plastic deformation of metal. Upsetting tests on aluminium alloy specimens under a vibrating load of 1200 kg (37 vibrations/sec., amplitude up to 1 mm) showed that vibrational deformation had a number of advantages over the ordinary slow upsetting. There was much less barrelling of the cylindrical specimens, the structure of the upset specimens and the hardness distribution in them were much more uniform, and residual stresses were less. The next step is obviously to do something about vibrational or ultrasonic working of metals.

Skimmer

AN OUTLINE OF CURRENT METHODS FOR PRECISE DETERMINATIONS

Analysis of Zirconium and Zirconium Alloys

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Current trends in the industrial usage of the newer metals, more especially those used in the nuclear engineering field, have demanded a revision of the techniques of analysis and trace determinations. At the Metals Division of Imperial Chemical Industries Limited, particular attention has been given to the requirements laid down by the specifications for zirconium and its alloys, and this article outlines the approach used for assaying these materials.

SPECIFICATIONS associated with the commercial production of zirconium and allied materials, for use in atomic power engineering, have imposed a very heavy burden on the analytical chemist. A typical specification includes no less than twenty-eight elements, and this formidable list is calculated on the supposition that the entire rare earth family of elements is reckoned as a single element. Moreover, the specifications concerned impose a maximum allowable content of a few parts per million for many of the elements.

When a new commercial product is introduced, and the analyst is called upon to carry out specific assays, his thoughts invariably turn to well-established methods of analysis, and frequently he is able, with simple improvisation, to extend such procedures to his particular problem. For example, the method of determining nickel, particularly in its final stages, is essentially the same whether applied to the examination of a mild steel or to a sample of margarine. In many instances, conventional analytical procedures can be applied to the determination of alloying constituents in zirconium-bearing materials; the volumetric determination of chromium is a good example. This method, based on preliminary solution of the sample, oxidation of chromium to chromate and titration with a standard reducing agent, is a principle that can be applied to the determination of, say, above 0·25 per cent of chromium, in a variety of materials.[1] The determination of alloying constituents in zirconium alloys is relatively straightforward, and this assignment is usually the least of the analyst's worries. His problems, however, become more acute when requests are made for determinations involving fractional parts per million of a specified element, and some of the twenty-eight elements referred to earlier fall into this category.

The methods by which these problems are approached depend largely on existing apparatus within the laboratory, and capital available for the purchase of additional equipment. In embarking on analytical problems of such magnitude, a decision has to be made as to the extent to which additional instrumental methods are essential, or highly desirable. Obviously the smaller the initial capital outlay, the easier this decision will be, but when instruments such as those involving X-ray fluorescence and mass spectrometry are considered, the analyst is not the sole arbiter in such matters, and his memory is refreshed by the words of Alexander Pope:—[2]

"In words as fashions the same rule will hold,
Alike fantastic if too new or old.
Be not the first by whom the new are tried,
Nor yet the last to lay the old aside."

In many respects the analytical chemistry of zirconium is similar to that of titanium, and this has minimized the analyst's difficulties, because of the extensive knowledge acquired in this field over the past five or six years.[3] Even so, specifications associated with zirconium are invariably far more extensive than those associated with titanium, and the analyst must at all times give special attention to a favourable compromise between accuracy and speed. Where the product is subjected to routine analytical control, these factors, and an added element of simplicity, are of paramount importance.

Sampling

It is not intended to enter into a discourse on how to obtain a representative sample, because this will depend largely on the form of the material to be examined.

In the preparation of all samples, traces of oil, grease, moisture, or any other foreign contamination, and conditions likely to cause oxidation or nitriding, must be avoided; this applies to all machining operations. A lubricant must only be used when essential, and extraneous iron must be removed from prepared samples by means of a magnet.

Materials are sampled by drilling or machining, after removal of surface oxide skin produced during heat-treatment, etc. Samples in a finely-divided condition are preferred, except for oxygen and hydrogen determinations, where solid samples are desirable.

Zirconium and its alloys can be machined successfully on conventional machine tools, provided certain essential requirements are satisfied. In all machining operations, rigidity of both workpiece and cutting tool is essential. To achieve this the machine tool must be in good condition. Zirconium has a tendency to gall or smear on to other metals; at all times, therefore, sliding contact between the workpiece and its support must be avoided.

In general, cutting speeds should be low and feeds should be as small as possible, depending on the strength and rigidity of the tool. Tool materials may be of high-speed steel, cast alloy or tungsten carbide, and trial cuts should be made in order to establish optimum machining conditions.

Top rakes for tungsten carbide tools should be from 6° positive to 7° negative, depending on the severity of the operation. Cast alloy tools operate best with 5° positive rake, and high-speed tools with up to 15° positive rake. In all cases a relief angle of approximately 7° is recommended.

Zirconium may be drilled with short high-speed steel drills, and holes should be as shallow as possible. For small sizes, below ¼ in., a 130° point is best, though on larger sizes, a 90° or a double-angle point is better. If long holes, of a depth greater than five diameters, are needed, it is helpful to retract the drill at intervals and clear the swarf. A continuous feed of about 0·002-0·005 in/rev. for small sizes, and 0·005-0·009 in. for larger sizes, should be maintained.

Sawing can be achieved at about one-quarter to one-fifth of the speeds used for sawing steel of comparable hardness. Where it is permissible to use a lubricant in sawing operations, paraffin oil is recommended, but steps must be taken to ensure its complete removal before the specimen is used for analysis.

Whatever type of tool is used, it is essential to keep it sharp and to replace it before appreciable wear occurs, because, once started, tool wear accelerates rapidly and the sample surface may be contaminated.

All sample preparations must aim at minimizing evolution of heat, and for this purpose the need for light cuts, light feeds and/or slow speeds cannot be over-emphasized.

Because of the pyrophoric nature of finely-divided samples, it is advisable to retain millings and/or drillings, immediately after they are prepared, in a non-combustible container.

Solvent

Zirconium is relatively insoluble in all concentrations of common mineral acids, such as sulphuric, hydrochloric or nitric. The most suitable solvent is a combination of dilute sulphuric and fluoboric acids, but a valid objection to the use of this reagent is that it introduces large quantities of boron into the

analytical laboratory. This can be a potential source of error, because very small amounts of boron (<0·5 p.p.m.) are determined in zirconium and allied materials. Solution in hydrofluoric acid alone is satisfactory, but this involves platinum or "Alkathene" apparatus.

There are occasions when it is an advantage to dissolve the sample in a mixture of hydrochloric/fluoboric acids, and a preliminary fusion of the material in a mixture of potassium bisulphate and concentrated sulphuric acid is sometimes recommended.

Oxygen and Hydrogen

Conventional "vacuum fusion" procedures for the determination of oxygen in materials such as titanium cannot be applied to the determination of oxygen in zirconium, because the yield of carbon monoxide is not quantitative. By incorporating a molten platinum bath into this procedure, zirconium-bearing materials are known to yield their total oxygen as carbon monoxide (hydrogen is also evolved quantitatively), and this is the basis of the determination.[4] The molten platinum dissolves a small amount of carbon from the graphite holder and this, in turn, reacts with oxygen in the weighed sample, to form carbon monoxide. In earlier types of "vacuum fusion" equipment, carbon monoxide, and hence oxygen, was determined by conventional gas analysis, based on removal of the gas from the apparatus, oxidation in the presence of excess oxygen, using spark discharge, and measurement of the contraction in volume according to the equation:

$$2\,CO + O_2 \rightarrow 2CO_2$$
$$3\text{ vol} \quad \rightarrow 2\text{ vol}$$

Carbon monoxide was also frequently determined by a procedure based on solubility of this gas in ammoniacal cuprous chloride.

Advantages of the molten platinum bath modification were soon apparent, and now both titanium- and zirconium-bearing materials are examined in our laboratories by this latest procedure, which involves conversion of carbon monoxide to carbon dioxide, by catalytic action at room temperature of activated manganese dioxide ("Hopcalite"). Gaseous carbon dioxide is subsequently frozen in liquid nitrogen, the contraction in volume is calculated from differential pressure measurements and this forms a basis for evaluating the oxygen content of the sample. All stages of this modified method proceed *in situ* and, in addition, can include the simultaneous determination of hydrogen, based on the change in internal pressure when hydrogen is diffused to atmosphere through a heated palladium osmosis thimble.

Where hydrogen alone is to be determined, a procedure based on "vacuum extraction" at about 1,200°C. is used.[3] In earlier "vacuum extraction" procedures, it was customary to isolate the gaseous product from the apparatus and determine hydrogen by conventional methods of gas analysis, usually by spark discharge, as in the comparable method for determining carbon monoxide. Hydrogen evolved by "vacuum extraction" is now determined from the change in pressure within the system, following diffusion of hydrogen through an osmosis thimble; a procedure referred to earlier.

The molten platinum bath method requires relatively small sample weights (15-45 mg. for nominal oxygen contents) and results obtained are as precise, and more informative, as those obtained using the larger sample weights necessary in macro "vacuum fusion" procedures—the platinum has a high recovery value.

Using this semi-micro platinum bath procedure, the time per determination, compared with the macro method, has been improved by a factor of about ten. Once the apparatus has been loaded and stabilized—this usually takes about 1½ hr. at the beginning of a working day—a single determination of both hydrogen and oxygen can be completed in about 10 min. Under favourable conditions, ten samples can be analysed, in duplicate, in a normal working day, with sufficient time to spare to enable the detachable part of the apparatus to be loaded with weighed samples for the following day's run.

Nitrogen

It is essential that the surrounding atmosphere shall be free from ammonia, nitrogeneous and acidic vapours, and the assignment of a room specifically to ensure this is strongly recommended.

This determination is based on conversion of nitride nitrogen to ammonia, by nascent hydrogen generated during solution of the sample. The problem then becomes one of determining ammonia, and the choice of procedure depends almost entirely on the amount of ammonia to be determined.

After solution of the sample in fluoboric acid/sulphuric acid solvent, an ammonium salt is present and free ammonia is regenerated by the addition of excess sodium hydroxide followed by distillation.

There are two well-known methods for determining ammonia in the distillate. One is based on the colour produced by the reaction of ammonia with Nessler's reagent, briefly referred to later. The alternative procedure is primarily intended for determining comparatively larger amounts of ammonia; the distillate, in such determinations, is collected in a solution containing excess of boric acid. Using a suitable indicator, it is possible to make a direct titration of the ammonia with a standard acid solution, without interference by the excess boric acid.

When ammonia reacts with sodium phenate in the presence of sodium hypochlorite, indo-phenol is formed[5] and this is the basis of a third procedure now in regular use in the company's laboratories. This is the most sensitive of the three procedures, and it is particularly useful in the examination of samples containing very small amounts of nitrogen.

The time taken for a single determination by each of the three methods outlined is about an hour.

Spectrographic Procedures

Spectrographic examination of zirconium consists of excitation of the oxidized sample and comparison of the resulting spectrum with spectra of zirconium oxide of known composition. *Aluminium, cobalt, magnesium, manganese, molybdenum, nickel, silicon, titanium,* and *vanadium* are elements determined in this way.

Weighed amounts of normal oxides of these metals are combined and ground into a uniformly mixed powder, and this provides a master standard. A weighed amount of this powder is intimately mixed with a weighed quantity of "pure" zirconium oxide ("Specpure"—Johnson, Matthey and Co. Ltd.) and this provides the main working standard. This standard is used in further "dilutions" with weighed amounts of the same quality zirconium oxide, and in this way a suitable range of standards is obtained.

Using four standards prepared in this way, it is possible to provide for the determination of all nine elements; these standards correspond to a range of impurity levels above and below the limiting values, e.g. one contains the specified limit of the impurity, others twice, half, and a quarter of the limit.

Hafnium is also determined spectrographically, and an independent range of six standards is prepared in a similar manner; as before, the range of the element is fixed in accordance with specification limits. ("Pure" zirconium oxide from another source is used.)

In all determinations, a Hilger large quartz spectrograph and a "B.N.F. General Purpose Source Unit" are used. Excitation and exposure conditions, wavelength ranges, etc., vary, depending upon the element to be determined, and comparisons of spectra are made either visually or by means of a micro-photometer, following excitation of about 5 mg. of the oxide, contained in the shallow crater of a ¼ in. dia. graphite rod. The oxide is first mixed with a minimum amount of Damarda resin, then cured at 130°C. for 1 hr. Impurities are determined by comparisons of intensities of characteristic line pairs, with due consideration for background variation, etc.

The reproducibility of the method, based on a single visual comparison, is about 30 per cent; the mean of duplicate tests should, therefore, be within 20 per cent of the true value. Determination of optical density, by means of a microphotometer, improves these reproducibilities to about 15 per cent

and 10 per cent for single and duplicate determinations, respectively.

The very low levels of impurities in zirconium make it highly desirable that the same elements in the "pure" zirconium oxide should be virtually absent This, however, proves impracticable, especially in relation to the hafnium content, and the spectrographer is faced with the problem of establishing the level of specific impurities in this basic material before reliable corrections can be made. Unless alternative reliable data are available, these levels are best determined by the principle of extrapolation.

A typical calibration curve, obtained for magnesium, without any blank correction, is shown at A in Fig. 1.

Because magnesium (2,794·8Å) could be detected, even when no addition of the metal had been made, it followed that magnesium was present in the "pure" zirconium oxide. An assessment of the amount of magnesium present was made by re-plotting the calibration curves, after making a constant addition of magnesium to each of the nominal compositions. Curves shown in the figure were obtained, and since a linear relation should exist between log. intensity ratio and log. concentration, the addition which produced a straight line (4 p.p.m.) gave a reasonably accurate value for the magnesium content of the "pure" zirconia. Other impurities may be determined similarly.

In the spectrographic examination of zirconium, limitations exist in that the low permissible concentrations of some impurities do not provide sufficient optical density changes to enable accurate measurements to be made with a conventional microphotometer, and, to overcome this difficulty, the conventional type of microphotometer can be modified. In principle, this modified instrument causes the photographic plate to oscillate automatically through the light beam incident on the photo-electric cell which, in turn, gives a direct indication of the optical density of the line under examination. After amplification, the cell output is utilized to deflect, in a vertical direction, the beam of a long persistent cathode-ray tube. Horizontal measurement of the beam is synchronized with the plate displacement, and this results in a cathode-ray sweep which relates transmission with wavelength.

Using this modification, it has been possible to effect an improvement in precision by a factor of at least three. The need to plot log. values, as in Fig. 1, is obviated, and this simplifies the background correction.

Once calibration curves have been prepared, a single determination of the ten elements can be completed in about 5-6 hr.

Rare Earths

Because of their high thermal neutron absorption cross-section, only trace amounts (less than 15 p.p.m. total) of the rare earth group of elements can be tolerated in zirconium used for construction components in thermal nuclear reactors.

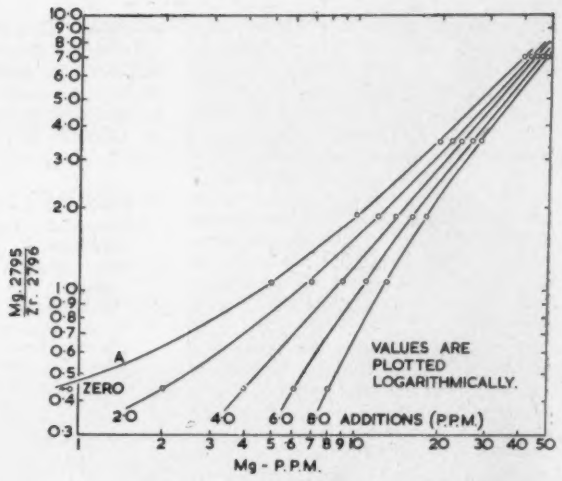

Fig. 1 — Calibration curves using nominal compositions with various additions of magnesium and a conventional microphotometer

Analytical procedures based on spectrographic examination of mixed rare earth oxides, following preliminary concentration and purification, are among the most sensitive and accurate methods for determining very small amounts of rare earths. Such a procedure has been described by Hettel and Fassel[6] for the determination of fractional parts per million of several rare earths in reactor grade zirconium. In this published procedure, a large sample weight (100 gm.) is dissolved in hydrofluoric acid, and yttrium is added as a carrier. In simple solutions, rare earth fluorides are quantitatively precipitated by hydrofluoric acid, but in the presence of a high concentration of fluorozirconate anion, solubility products of the rare earth fluorides, estimated to be about 10^{-17}, are not exceeded, and hence precipitation does not occur. Hettel and Fassel separate fluorozirconate from yttrium, rare earths and other cations, by passing the sample solution through a cation-exchange column; yttrium and the rare earths are retained, then eluted, and subsequently separated from interfering elements by a series of chemical procedures. Individual rare earths, gadolinium, terbium, holmium, dysprosium and samarium, are determined spectrographically in the final oxide residue.

The added yttrium serves as an internal standard in the spectrographic examination and provides a convenient means of overcoming error due to factors such as incomplete absorption on the ion-exchange column and loss of rare earths during the chemical purification. The ratio of rare earths to yttrium is the important consideration because this is the basis of the final evaluation of the rare earth content of the sample.

The method recommended by Hettel and Fassel is reliable but time-consuming. We have shown that the procedure can be shortened by reducing the length of the ion-exchange column, the flow rate and the volume of hydrochloric acid used for the elution; the provision of a continuous extraction apparatus for the removal of iron (ferric thiocyanate is extracted with ether) also shortens the procedure. Using these modifications reduces the time for a single determination from four to three days.

Our latest procedure differs from that of Hettel and Fassel in that use of an ion-exchange column is avoided; the spectrographic method of completing the determination is also different. Use of yttrium, however, is retained for the purposes already described but, in addition, ytterbium (equivalent to 0·4 p.p.m.) is added. Insoluble fluorides of yttrium and the rare earths are precipitated and subsequently purified by a series of chemical procedures. Determination of the individual rare earths is then completed spectrographically by a procedure similar to the method described earlier, using standards prepared from weighed amounts of the normal oxides of each rare earth dissolved separately in hydrochloric acid (except cerium oxide, which is first fused in potassium bisulphate) and subjected to an appropriate part of the chemical purification treatment.

Lanthanum, cerium, praseodymium, neodymium, samarium, europium, gadolinium, terbium, dysprosium, holmium, erbium, thulium and *ytterbium* are rare earths determined in this way.

The lower limit of detection, for individual rare earths, varies between 0·02 p.p.m. for ytterbium and 0·5 p.p.m. for cerium; the lower limit for total rare earths is about 3 p.p.m., but the sensitivity of the method can be increased by using a larger sample weight.

A single sample for the specified rare earths can be analysed in about two days.

Flame Photometry

In the year 1859, Bunsen discovered rubidium and caesium by means of a

spectroscope, using a platinum wire dipped in salts of these elements, moistened with hydrochloric acid, and his own Bunsen flame. Because flames excite only the lower energy levels of the atom, and hence give rise to transient spectra, poor in characteristic lines, the use of flames in spectroscopy is restricted. Even so, rapid progress has been made over the past twenty years, and to-day several reliable flame photometers, designed primarily to determine constituents in solution at the p.p.m. level, are available commercially.

Calcium and *lithium* are determined by flame photometry, but because of the very small amounts of these elements present, a preliminary concentration of each is necessary, and this is achieved by use of a cation exchange column. Calcium and lithium are retained on the column and are subsequently eluted and determined flame photometrically.

Both determinations proceed simultaneously, and a single determination of both elements takes about 3 hr. to complete.

Atomic Absorption Spectrometry

The principle of atomic absorption spectrometry has been known to astronomers for a long time, but it was only as recently as 1955 that the first Paper of analytical interest incorporating this principle was published.[7]

It is in consideration of the distribution of atoms in different energy states that the author (Walsh) finds the principle of atomic absorption spectrometry as a potential analytical technique so attractive.

The concentration of atoms in a flame is determined by absorption of light at the same wavelength as the same line of the element to be determined; this light is obtained from a "hollow cathode" lamp which incorporates the metal to be determined. The light source must emit the spectrum of the element to be determined, and its light must pass through the flame into which the sample is sprayed, and thence to a monochromator isolating one of the resonance lines. Suitable means must be provided for measuring the relative intensity of the line before and during the spraying of the sample solution, and from the ratio of these measurements the absorption coefficient is determined. This absorption method, which involves measuring the ratio of two light intensities, has a clear advantage over any attempt at absolute intensity measurement in emission spectroscopy. The temperature of the flame is not critical, but must be sufficient to vaporize the sample completely, and the sample must be sprayed at a very steady rate.

Zinc is determined in zirconium by "atomizing" a solution of the sample into a flame, and through that flame passes light from a "hollow cathode" lamp, provided with a zinc (brass) electrode. This procedure is extremely valuable for determining this element, not only in zirconium but in many other miscellaneous materials. It has a high order of sensitivity and presents no difficulty in permitting a few parts per million of the metal to be determined. A complete instrument is now commercially available,[8] but very little development work has been carried out on atomic absorption spectrometry in this country.

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(To be concluded)

Men and Metals

It has been announced that, as from the beginning of next year, **Lord Plowden,** chairman of the Atomic Energy Authority since 1954, is to become chairman of the British Aluminium Company Limited and vice-chairman of Tube Investments Limited.

On Wednesday of last week, the Lord President of the Council presented the Wolfe Award, in the form of a cheque for £500, to **Dr. L. Essen,** O.B.E., D.Sc., Ph.D., A.M.I.E.E., at the Privy Council Office. Dr. Essen, a Senior Principal Scientific Officer at the National Physical Laboratory, was selected for the award on account of his work on the establishment of an atomic frequency standard as a basis for the future standard of time.

Staff changes in their Research Group are announced by the United Kingdom Atomic Energy Authority as follows:—**Mr. D. W. Fry** has been appointed director of the Atomic Energy Establishment at Winfrith, and **Dr. F. A. Vick,** O.B.E., has accepted an appointment as deputy director of the Atomic Energy Research Establishment at Harwell. Mr. Fry is at present deputy director at Harwell and Dr. Vick is head of the Department of Physics at the University College of North Staffordshire.

It is understood that on March 31 **Mr. Adam Dunlop,** F.I.M., will resign his position as development manager of the Exothermic Division of Foundry Services International Ltd. on his appointment as managing director of Investril Casting and Metallurgical Services Ltd.

Feeney Professor of Physical Metallurgy at the University of Birmingham and head of the Department of Physical Metallurgy, **Dr. G. V. Raynor** has been elected a Fellow of the Royal Society. Dr. Raynor has been at Birmingham University since 1945, and in 1951 he was awarded the Walter Rosenhain Medal by the Institute of Metals for outstanding contributions in the field of physical metallurgy.

Recent appointments announced by Chas. Carr Limited are those of **Mr. F. C. Marsland** as a director and chairman, and **Mr. J. Goodridge** as a director.

News from the Metropolitan Electric Cable and Construction Company Limited is to the effect that **Mr. J. H. Sutcliffe Ross,** Assoc.I.E.E., and Member of the Association of Mining Electrical and Mechanical Engineers, has been appointed sales manager in succession to **Mr. T. C. Johnston,** who is now a director and general manager of the company.

Elected for a third term of office as chairman of the Aluminium Industry Council, **Mr. H. G. Herrington** is managing director of High Duty Alloys Limited.

Resident director of the Mond Nickel Company Limited at Clydach, Swansea, **Dr. A. G. Ramsay** has been installed as a junior vice-president of the Industrial Association of Wales and Monmouthshire.

Appointed a director of Baird and Tatlock (London) Ltd., and also of Hopkin and Williams Ltd., **Mr. Robert Douglas Baird,** B.A., is a grandson of the founder of Baird and Tatlock (London) Ltd. He was educated at Winchester and Cambridge, where he read for the Mechanical Sciences Tripos. Since 1947 he has been teaching mathematics at Eton, where he is also the careers master.

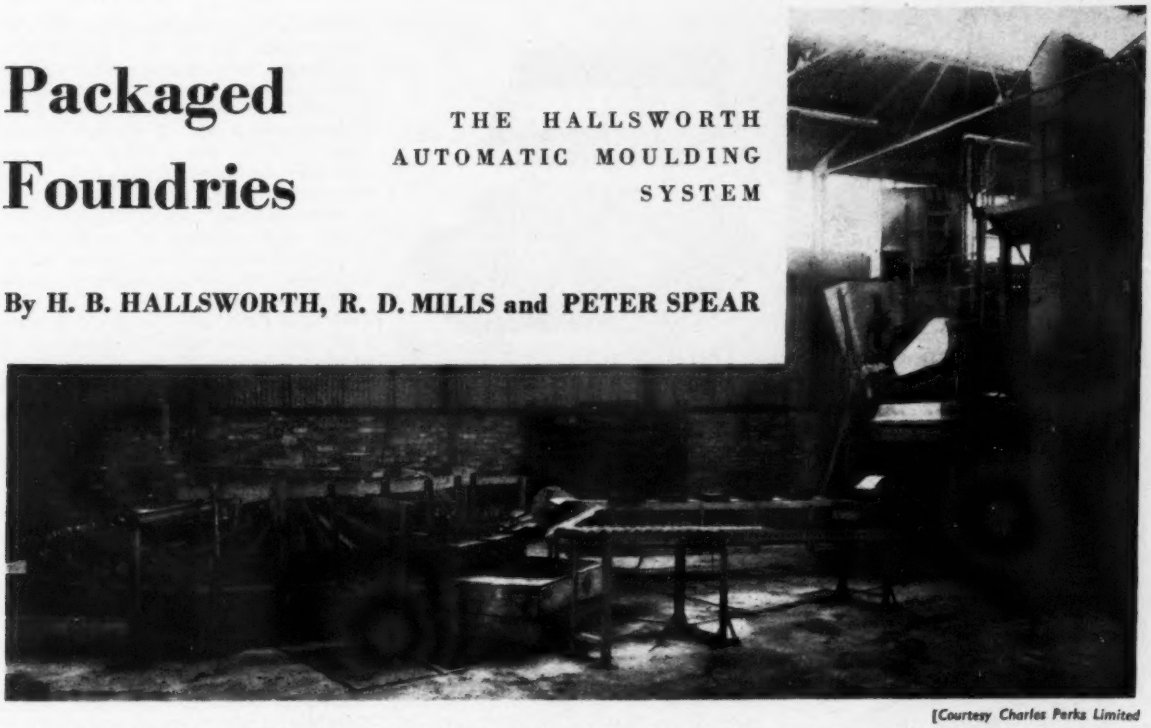
Appointed chairman of the West Midlands branch of the Institute of Export is **Mr. P. W. Underhill,** who is chief shipping officer at Birlec Limited. Mr. Underhill has been with Birlec for 27 years, and became chief shipping officer in 1950.

Late of British Paints Ltd., **Mr. J. G. Marsden** has joined Anti-Dust Services Limited as general sales manager in charge of U.K. sales.

Packaged Foundries

THE HALLSWORTH AUTOMATIC MOULDING SYSTEM

By H. B. HALLSWORTH, R. D. MILLS and PETER SPEAR



[Courtesy Charles Perks Limited

Fig. 1—A view of a typical, complete installation showing the sand processing unit, the rotary casting track and other ancillary equipment

A NEW approach to an old industrial problem is described in this survey—that of producing medium or large quantities of accurate ferrous and non-ferrous sand castings of a size order that could be accommodated in an assembled moulding box of the order of 12 in. by 9 in. by 5 in. In a conventional foundry it would be usual to use a larger box than this, moulded by hand with, possibly, machine squeezing and stripping followed by hand assembly and pouring under traditional foundry conditions.

In direct contrast, the present system employs the principle of using relatively small, easily handled, moulding boxes with completely automatic equipment as and where necessary, but still retaining the human element if justified by economics. At the same time, the system is flexible to facilitate the use of a number of pattern plates within a single shift without any more adjustments than can be undertaken by a semi-skilled mechanic.

The arrangement is centred on an automatic moulding machine which automatically sprays, charges with sand, edge tucks, squeezes, removes surplus sand, strips and deposits the mould on to a conveyor track ready for assembly. This entire sequence is carried out on a four-station machine served by a number of ancillary appliances keyed to its operational sequence.

A typical complete installation is depicted in Fig. 1.

In order to ensure that the complete cycles of operation could be handled by equipment of a reasonable size, the conception required a basic idea of a relatively small moulding box. Fast movement of a small moulding box requires fast moving equipment, which is probably cheaper and certainly easier to handle than large, ponderous equipment. Further, it was soon evident that in the manufacture of small castings, a small, rapidly moving box yielded a greater output per man than a large box, where the time cycle is adversely affected by both operator fatigue and the necessity for larger mechanical handling equipment.

For the first design, which is commercialized, an assembled moulding box size of 12 in. by 9 in. by 5 in. has been selected. Characteristics of the moulding box, shown in Fig. 2, are:—

(1) All half boxes must be precision made and interchangeable.

(2) All boxes must be suitably designed for vertical pouring, with its associated benefit of smaller running system and higher casting yield.

(3) A small box implies easy handling and thus, where manual operation is economically desirable, operator fatigue is reduced.

(4) Pattern making costs are less compared with the cost of pattern plates for large boxes, and the small pattern plate is changed easily. Typical patterns are shown in Fig. 2.

(5) It must be understood that it is the rate of turnover of boxes which controls the rate of output rather than the size of the box.

(6) The small box tends to prevent the occurrence of "sand slip."

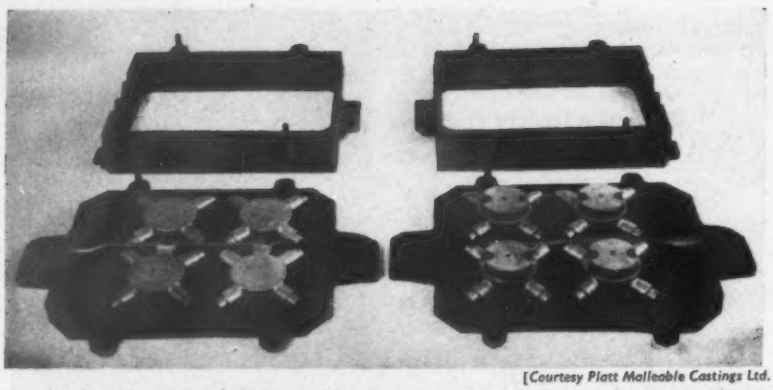
(7) With various shapes of castings it is possible for the small box to maintain the ratio of area of castings to area of box at a high level.

Layout

The schematic diagram in Fig. 3 shows a complete layout of the plant designed according to the above principles. The four conveyors, i.e. sand supply, coring, box return, and underground sand return conveyors, have been arranged to provide the necessary linkage between the three main cycles of sand, metal and box movement. The supply of these three materials, plus compressed air and electricity, enables the system to function immediately as a complete foundry unit.

As a result of the overriding policy of producing a compact, efficient moulding unit, the complete plant can be accommodated on a concrete apron approximately 30 ft. by 60 ft.

No arrangements have to be made for heavy plant and an overall thickness of 6 in. of concrete, a conventional arrangement, is quite ample. It should be noted, however, that because of the flexibility of plant the particular size suggested is not mandatory, and the length/breadth overall plan ratio could be increased or reduced according to local requirements.



[Courtesy Platt Malleable Castings Ltd.

Fig. 2.—Two 12 in. × 9 in. × 2½ in. moulding box parts, and their associated pattern equipment

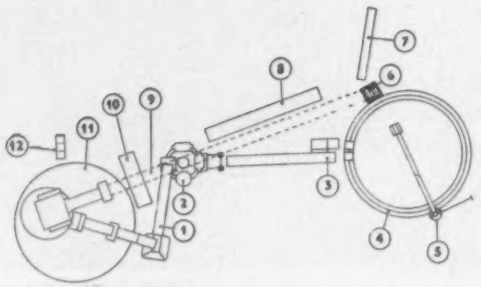


Fig. 3.—A schematic diagram showing the layout of a typical unit. As depicted the installation would take up a floor area of 60 × 30 sq. ft.

Key
1—Sand feed conveyor
2—Automatic moulding machine
3—Coring conveyor
4—Rotary mould conveyor
5—Pouring mechanism
6—Shake-out
7—Casting delivery conveyor
8—Mould box return conveyor
9—Underground sand return conveyor belt
10—Magnetic separator
11—Sand reconditioning plant
12—Control panel

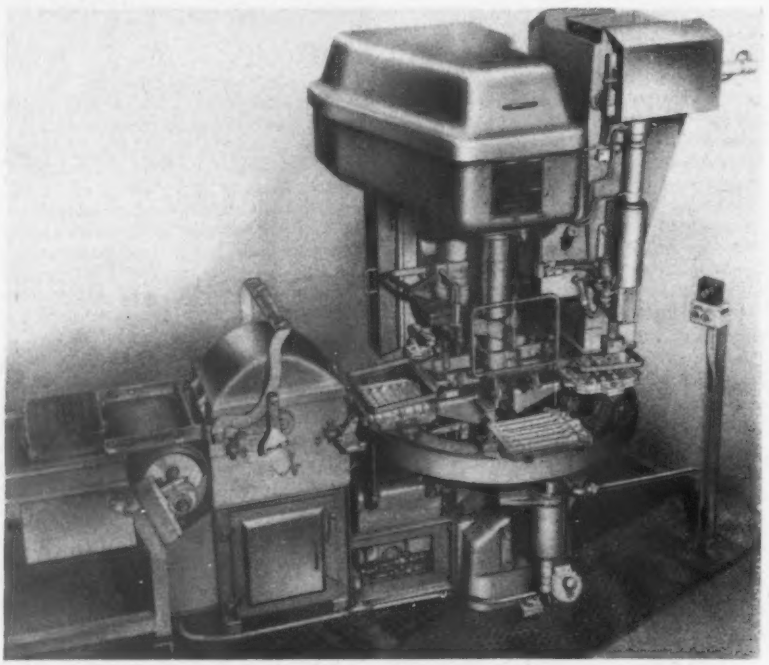
The size suggested, however, gives a reasonably economical plant using the minimum lengths of conveyors.

The transfer of spent sand and its elevation to the sand reconditioning plant necessitates an underground conveyor pit approximately 30 ft. long, 5 ft. wide and 6 ft. deep, which is connected to a shaped pit of approximately 10 ft. square by 7 ft. 6 in. deep, in which are housed the bucket elevators. The magnetic separator necessitates a separate pit 5 ft. by 3 ft. by 4 ft. deep. Under normal conditions, the foundation pits are lined with a 6 in. thick layer of concrete, terminating in some instances in a shaped lintel.

Automatic Moulding Machine

A general view of the Hallsworth automatic moulding machine, Mk. II, is given in Fig. 4.

Fig. 4—The Hallsworth automatic moulding machine MK II



The machine consists of four stations and a rotary table which automatically conveys the half-box and pattern from station to station. At the first station the operator, after locating the box part on the pattern plate, pulls down the vertically positioned hinged sand allowance frame on to the box part. The table indexes to station 2 to receive sand and in its arc of movement is subjected to a spray of parting fluid. A semi-rotary hopper turns through 180° discharging sand upon the box part mounted on the table. A frame fitted to the sand chute then moves downwards compressing the sand round the edge of the mould, i.e. "edge tucks." The table then indexes to station 3 for the main squeeze operation. During this movement the sand filled box part passes under an adjustable sand levelling device, which strikes off surplus sand, i.e. the "static strickle bar." Following the main squeezing operation, the table indexes to station 4. During the movement from station 3 to station 4, the hinged sand allowance frame is restored to the vertical position to enable the scraper bar to strickle the mould. The pattern plate is vibrated and the mould stripped, to be received by the take-off arms which by now have moved into position. The cycle is completed when the take-off mechanism places the half mould face upwards on to a moving belt conveyor. It will be appreciated that all the operations described take place simultaneously, and four boxes and patterns are in use at any instant.

It is necessary for an operator to be present, but his sole functions are:—(1) Visually examine pattern plate and clean with compressed air gun if necessary. (2) Position box part. (3) Bring down sand allowance frame.

None of these operations is fatiguing to any great extent, and all the essential moulding operations are carried out automatically.

Principle of Operation

The basic principle is to use the table indexing mechanism as the master control, steering the operating cycle and thus ensuring that no overlapping of operations can occur. Concise control of operation speed is obtained, where necessary, by mechanically linking a hydraulic dashpot system to a pneumatic power system.

Motive power for table rotation is supplied by a pneumatic cylinder, its speed controlled by a hydraulic cylinder. Overall cycle time is controlled electrically by process timers, individual cylinder speed is controlled pneumatically by speed control valves.

Motion is transferred from the index cylinder to the rotary table by a pawl and indexing cam. The pawl is mounted in a carrier which oscillates around the indexing cam, thus imparting the necessary interrupted rotary motion. Movement is under the control of a hydraulic cylinder, ensuring that

starting and stopping the table is reasonably shockless. During the power stroke of the index cylinder the pawl is in the engaged position, so that motion is carried directly from the cylinder to the machine table via a pair of indexing plates and a vertical shaft. The shaft is mounted in top and bottom bearings, and has the pattern table keyed to it. Adjustable cams are attached to the indexing plates which control, in sequence, the primary ancillary operations which are performed when the table is in motion. The operations which are undertaken when the table is still are under the direct control of a pilot valve, which is actuated from a cam positioned on the mould take-off arms.

An emergency foot-operated solenoid stop control is fitted externally to the base casting. Depression of the control cuts off the supply of air to the machine and unloads all cylinders, thus bringing all motion to a standstill. As the corollary of this, the indexing mechanism has no load and the table can be moved freely by hand.

Table

Running between the cartridge bearing assemblies fitted to the base and head castings is a 3½ in. diameter hollow steel shaft, keyed to which is the four-station moulding table. The table is constructed to limit any surplus sand build-up by using an open structure, the principal members of which are shaped to a form designed to prevent sand adhesion.

Also fitted to the table driving shaft is an assembly of four hinged frames, so sprung that they occupy either vertical or horizontal positions. They are vertical during loading and unloading, and horizontal when edge tucking and squeezing. At the end of the cycle of mould production the frame is vertical, and one of the operator's functions after placing a new moulding box in position is to lower the frame where it is held down horizontally by over-centred springs. Between the squeezing and mould ejection stations (three and four) a projection at the back of the frame passes under a positioned wheel which forces the frame into the vertical position. The purpose of the frame is to contain surplus sand for ramming requirements, and to prevent spillage during these operations.

A steel chute is fitted to the moulding machine seen generally in Fig. 5. At the top of this chute is mounted a double-sided hopper which can be seen in the detailed view, Fig. 6. It consists of two opposed box-like compartments, one of which is always in a position to receive sand from the sand belt conveyor working with the reservoir hopper, described later. The double-sided semi-rotary hopper is mounted horizontally on two male bearings attached to a square shaft. At each indexed operation, the hopper turns through 180° in a clockwise or anti-clockwise direction, emptying the sand-filled compartment. The amount of sand entering the hopper between two indexing operations is controlled by adjusting the gate on the reservoir hopper, thus controlling the level of sand on the belt. The steel chute is fitted with a movable frame at its discharge outlet. This frame has four "keep" sides, the leading edges of which are flanged to squeeze the sand at the edge of the moulding box, and thus perform the function of "edge tucking." Vertical movement of the "edge tucking" frame is effected by two double-acting pneumatic cylinders. The overall dimensions of the frame provide a working clearance between

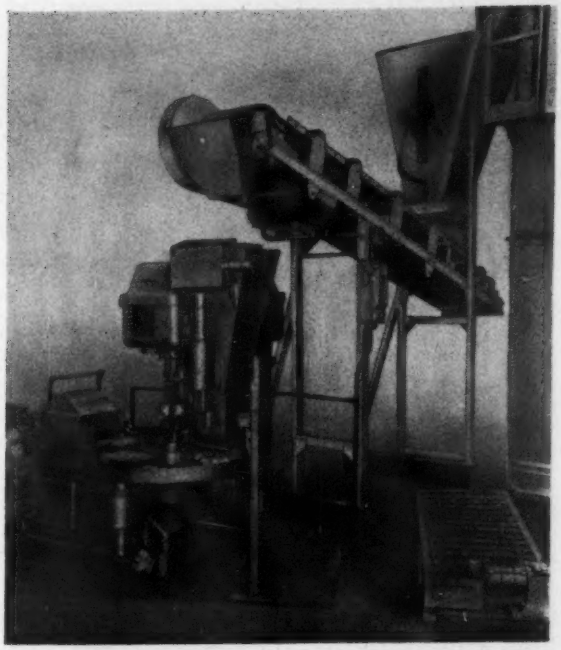


Fig. 5—A general view of the moulding machine and sand feed conveyor. The moulding machine sand chute is immediately below the sand feed conveyor. In the right hand corner the magnetic separator guard can be seen

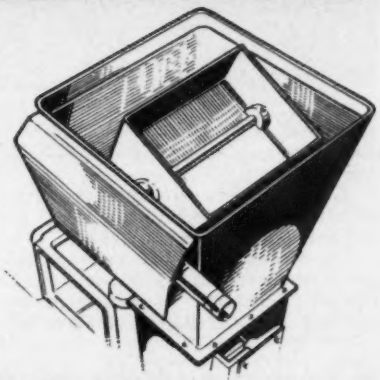


Fig. 6—The sand metering hopper shown in position in the sand chute

Fig. 7—A view of the mould take-off station of the moulding machine. The half mould has engaged in the take-off arms and is being transported towards the coring conveyor

Fig. 8—The scraper frame of the moulding machine seen cutting away surplus sand from the mould. Upon completion of its stroke the mould lift operates and the take-off arms engage on the mould for removal

the mould and the frame, enabling the squeezing force to go into the body of the sand.

Table deflection on load is prevented in a similar way to that described at the main squeeze station below.

The main squeeze cylinder is accommodated within the head casting, and operates vertically. Any variation of pressure required can be obtained by a pressure control on the airline.

The lifting mechanism consists of an aluminium casting on which are mounted four ejector pins positioned to locate at the corners of the box. Vertical movement of the unit is obtained by a specially-designed heavy duty air cylinder, to which two steadying hydraulic cylinders are coupled mechanically. Before the four pins are in contact with the box, a standard pneumatic vibrator comes into action on the underside of the pattern plate and continues during lifting, preventing sand sticking to the pattern and thus facilitating clean stripping.

The mould take-off, shown generally in Fig. 7, consists of two steel lifting arms, semi-rotatably mounted in self-aligning roller bearings, located on a steel frame. The arms are actuated by two trunnion-mounted cylinders, positioned in parallel, an air cylinder supplying motive power, and a hydraulic cylinder to control speed. The linear motion of the cylinders is transposed to angular movement by a rocker arm connected to the cylinder nose ends.

The two lifting arms are fitted with spring-loaded catches which engage corresponding projections on the moulding box. This method of attachment prevents any movement of the half mould relative to the arms, during its transfer from the machine to the coring conveyor, and yet allows it to be withdrawn smoothly by the conveyor.

The scraper mechanism has been designed to reproduce mechanically what is essentially a hand operation in normal circumstances. During this operation, either by hand or by machine, excess sand is removed from the mould back by the cutting action of the scraper bar or blade. It is essential that after the scraping operation the level of sand should not protrude above the top edge of the moulding box. A frame is fitted over, and pivoted to, the mould take-off lifting arms. In the moulding box discharge position, the scraper rests on stops with the leading edge facing towards station 4. A special, adjustable steel cutting blade is attached to the leading edge of the frame. Rollers are set flush either side of this scraper blade, designed to run along the opposing faces of the moulding box sides. When the take-off arms move to engage a mould, they are preceded by the scraper frame, and the semi-rotary movement of the arms is converted into a linear movement of the scraper frame. Thus, the scraper blade passes across the moulding box, cutting away excess sand, as shown in Fig. 8.

Fig. 9—A general view of the coring conveyor showing half moulds in transit, and a closed mould positioned on the slipway ready to load on the rotary castings conveyor
[Courtesy Charles Perks Limited

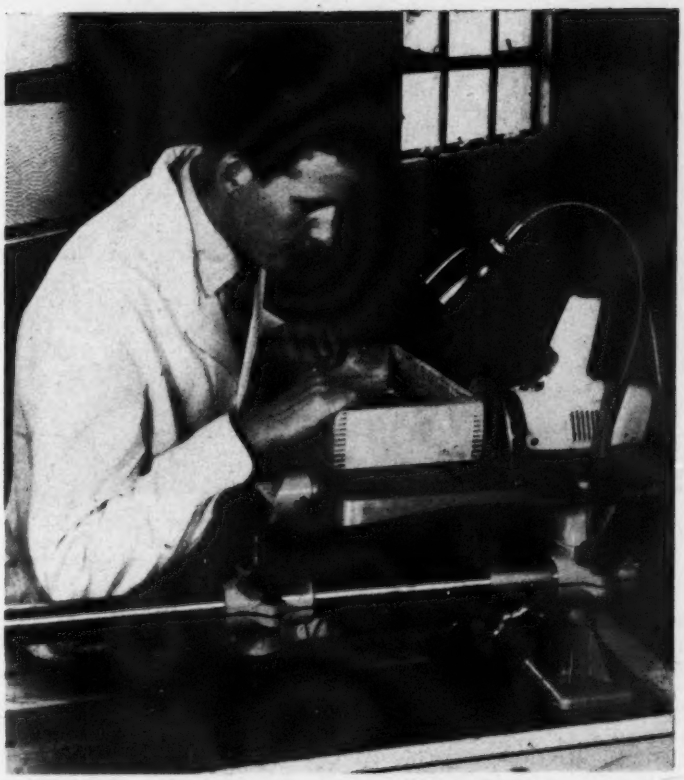
Coring Conveyor

A general view of the coring conveyor is given in Fig. 9, showing the half moulds after discharge from the take-off mechanism progressing towards the rotary track. Simple core laying is carried out while the moulds are in motion, and the half moulds then proceed towards the clamping mechanism, and are handled as described later. If more complicated coring is required, then semi-circular tables are positioned to the side of the coring conveyor, on to which the operator pulls the matching half moulds, lays the cores, closes over the cope mould, and restores the completed moulds to the conveyor.

(To be concluded)

Pressure Die-Casting Review

Die-Cast Two-Speed Drill



The Selecta 2-speed drill being used in conjunction with "Home-Master" workshop equipment

TOOLS for the handyman, the amateur craftsman and the professional have achieved sales figures that would have been undreamed of prior to 1950, and the potential market is still relatively large. The reasons for this growth of interest in the making of furniture, toys, and other things in and for the home, are more complex than might at first be apparent, but one of the factors that must not be overlooked in any assessment of this situation is the availability of the right tools at the right price. In this respect, the "do-it-yourself" market owes much to developments that have taken place in the industrial field, since the ability to make complex tools at a competitive price depends upon progress in production methods.

Anyone glancing over the array of "do-it-yourself" equipment at any large department store will see at once the effect of production processes on the design of most of the equipment shown, and if the observer is moderately familiar with the processes in use, he will note that the two major injection moulding processes—pressure die-casting and plastics moulding—dominate the production of small tools. This impression would be further substantiated in many instances if the tools on show were broken down into their separate components, and, in all probability, this would reveal an even greater preponderance of pressure die-castings.

As a case in point, consider the Selecta 4500 two-speed drill (Fig. 1), a product of Selecta Power Tools Ltd., Hampton Road West, Hanworth, Feltham, Middlesex, for which world patents and design registrations are pending. One of several power drills available for the amateur or professional craftsman, this drill, which has a capacity of $\frac{1}{4}$ in., employs four major die-castings in its assembly, two in zinc alloy and two in aluminium alloy, and, in addition, the motor end brackets are also pressure die-castings.

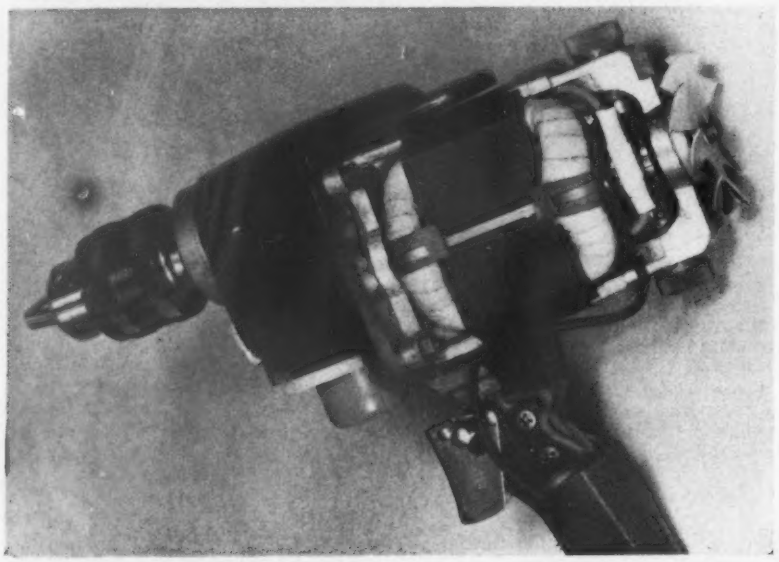
Fig. 1—The Selecta 4500 2-speed drill

One of the aluminium alloy side plates is shown in Fig. 2 as it has been removed from the drill assembly. The two side plates, which are similar except for small details, together form the handle of the drill and enclose the motor and fan assemblies. The side plates are thin-walled shells, each having louvre slots incorporated. Immediately in front of the louvre is a shallow web and this, together with two further small webs behind the louvre, in part assist to locate the side plates in relation to the gearbox and take the thrust from the gearbox. Three bosses are provided for fixing screws, each having cored-out holes and cast-in counterbores on the outside. A further cored hole adjacent to the trigger switch aperture accommodates the locking button for continuous operation.

In the drill assembly, shown in Fig. 3, the speed selector/indicator can be seen below the gearbox. This has a plastics indicator that projects, in the complete assembly, through a cast-in slot in the side plates. Further, the side plates are shaped to fit snugly

Fig. 2—The die-cast side plates of the Selecta drill

Fig. 3—Selecta drill with side plates removed to show the motor assembly, gearbox (black) and sandwich plate



round the gearbox and blend smoothly into the general contour. The successful blending of these die-castings necessitated a number of minor modifications to the dies before they were finally hardened, and the die trials thus involved close co-operation between designers, die-makers and die-caster.

Another feature of the side plate casting is the provision in the die-casting of a narrow slot around the rear aperture, into which a pressed grille is fitted at final assembly. Similarly, slightly forward of this slot is a cast-in web, and between this web and the pressed grille is assembled the axial flow extraction fan. In trial designs the fan was not shrouded by a web of this shape, and extraction was not entirely satisfactory. However, the inclusion of the present web, which provides a roughly circular aperture between fan and motor, immediately overcame this difficulty.

A feature of the grip design on the side plates may be seen in Fig. 2, which shows the outer surfaces of one of the side plates. The parallel ribs that provide a comfortable grip are cast-in, being carried round the back of the handle, but at the edge of the castings are run into a slight rib along the face. This avoids the serrations coming directly on to the parting line and simplifies the trimming of flash.

Apart from tapping and the cleaning up of the face by linishing, no other operations are carried out on the side plate castings. It is, therefore, apparent to what a considerable extent the use of pressure die-castings has contributed to production economy in these components.

The two zinc alloy castings are the gearbox and the sandwich plate, the latter acting as a mounting for both the gearbox and the motor, between which it is sandwiched (Fig. 3). This sandwich plate has a hollow domed section at the top that extends back over the motor and blends into the general contours of the drill. The cavity is cored out in the casting and avoids a heavy section at this point. In addition to fixing screw holes, the sandwich plate has cast-in bores for the location of the spigot of the gearbox. It also has main shaft bearing bores, which are bored out prior to assembly, as absolute squareness is essential for the smooth intermeshing of the gears carried on the three shafts of the gearbox.

As alignment is so vital in a tool of this kind, the assembly is made up first on a "dolly" to ensure location and alignment for the gearbox shafts and the armature. Further to ensure alignment and rigidity in operation, the forward end of the main shaft, which would otherwise be overhung, is supported in a roller bearing.

At its lower end, the sandwich plate has a tailpiece or platform in which are cast locations for the trigger and switch assemblies.

Much of the rigidity of the whole tool depends upon the sandwich plate, and it is of interest, from the die-casting viewpoint, that the only operations carried out on it are those of boring and facing, both of these being done at the one setting, and the tapping of two holes for the switch location.

The gearbox is, perhaps, the most critical die-cast component in this assembly and, as with the other die-castings, machining operations have been avoided wherever possible, although it is clear that any component of this kind will require some boring and facing. Seven holes are cored in the face, and the main bore and subsidiary bearing bores are all cored and subsequently bored. The layshaft bore is cast as a blind hole, the shaft being pressed in at assembly. The circlip for retaining the forward bearing is fitted into a machined groove. On either side of the gearbox, a cored hole is provided and tapped for securing the side plates. Cored through the lower end of the gearbox is a hole in which is fitted the speed change bush. This bush operates a sintered bronze glut that moves the double gear on the layshaft and thus selects the speed required, 4,500 r.p.m. or 2,500 r.p.m. As the speed is selected, an engraved plastics disc indicates which speed setting is being used.

The choice of speed is one of the features of this drill, since all other small power tools of U.K. manufacture are single speed only. Accessibility of brushes is another feature of this tool, the die-cast side plates being cast to accommodate the brush covers, and permit easy removal.

Contract Heat-Treatment Service

Birlec mesh belt conveyor furnace rated at 60 kW with 12 in. belt conveyor. Capacity is available for handling more than 40 tons per week of work for bright annealing, normalizing, brazing and tempering

FORMED specifically to provide a contract heat-treatment service to industry, and as a means of demonstrating a selection of standard Birlec heat-treatment furnaces under normal operating conditions, the Heat Treatment Division of Birlec Limited has been inaugurated in an extensive and modern works at Aldridge.

Capacity for the following heat-treatment processes is provided: bright annealing and normalizing; clean hardening and tempering; nitriding; carburizing and carbo-nitriding; low temperature treatments; and furnace brazing.

The facilities for bright annealing and normalizing, which were used to the full for a number of years at the old heat-treatment works at Tyburn Road, Birmingham, have been substantially increased. Capacity is available for processing upwards of 40 tons/week of work for bright annealing and normalizing. The process, which ensures the retention of a bright finish on ferrous materials, is carried out in mesh belt conveyor furnaces. Whereas a protective atmosphere of burnt town's gas (exothermic gas) is most commonly employed within the furnace, endothermic gas may be preferred for the treatment of medium or high carbon steels.

Dependent upon the nature of the components, furnace brazing may be carried out in either mesh belt or batch-type furnaces at Aldridge. Backed by the accumulated experience of copper brazing gained over a number of years, capacity is available for copper brazing mild steel or medium carbon steel assemblies, and also for furnace brazing using silver solders or other brazing alloys.

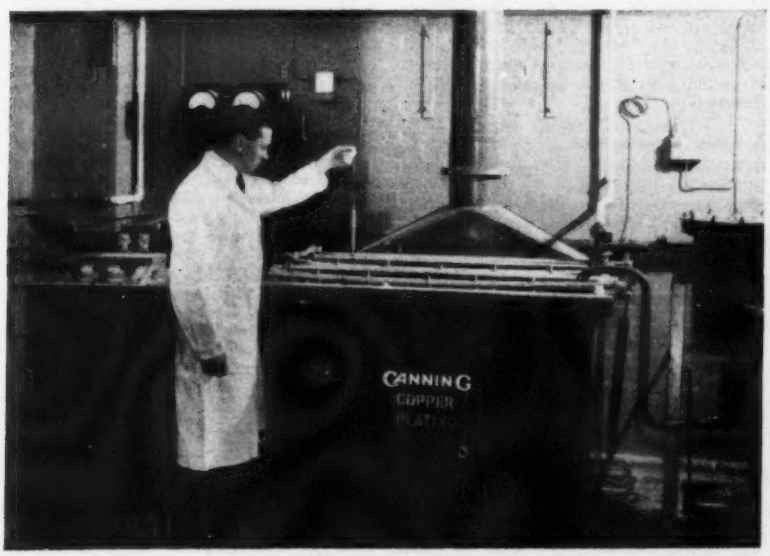
Up to 20 tons/week of bright hardening work can be carried out at Aldridge in Birlec shaker hearth furnaces and sealed quench furnaces. Tempering capacity is also available in vertical forced air circulation furnaces having charge spaces of 26 in. dia. by 24 in. deep.

Up to 10 tons/week is the available capacity for carburizing and carbo-nitriding work. Pack carburizing capacity and a small cyanide salt bath for the localized case hardening of small batches are also available.

At Aldridge, stress relief annealing, solution treatment, ageing, and other low temperature heat-treatment processes can be carried out in vertical forced air circulation furnaces having a charge space of 26 in. dia. by 24 in. deep. A water quench tank is available for quenching work from these furnaces.

To supplement the services listed above, equipment has been installed for a number of ancillary processes: descaling by pickling or shot blasting; copper plating for stopping-off carburizing or applying copper prior to brazing, and degreasing either by trichloroethylene or alkali wash, a service often of great benefit to customers possessing no degreasing facilities.

Copper plating facilities at the Birlec Heat Treatment Division



Obituary

Mr. A. Dando

IT is with regret we record the death of Mr. Andrew Dando, who, until his retirement in 1957, was chairman of Hall Street Metal Rolling Company Limited, Birmingham. Mr. Dando joined the company in 1918 as secretary, becoming managing director and, later, chairman. He was also chairman of the Brass Wire Association and of the Cold Rolled Brass and Copper Association.

Industrial News *Home and Overseas*

Packaging Techniques

Sixteen leading companies in the aerosol packaging field have been responsible for the educative display which may be seen at the Packaging Centre, in Poland Street, London, W., and which remains open until April 8 next. Together they cover every stage and aspect of the new packaging techniques, propellents, valves, glass and metal containers, coatings, formulations, machinery and equipment, contract filling, etc.

The display has been planned to give a complete, clear picture of what makes an aerosol or pressurized pack. The individual exhibits are supported by an illustrated guide to the processes used, the manufacturing sequence, recent technical developments and possible future applications.

A separate section shows some of the successful products now being put up in aerosol form. The firms taking part in the interesting exhibition are as follows: Aerosol Packaging Co. Ltd.; John Dale Ltd.; W. J. Bush and Co. Ltd.; Day Son and Hewitt Ltd.; Givaudan and Co. Ltd.; Imperial Chemical Industries Limited; International Bottle Co. Ltd.; Metal Box Co. Ltd.; Midland Aerosols Ltd.; Polak and Schwarz (England) Ltd.; Pressure Aerosols Filling Co. Ltd.; Aerofil Ltd.; Chas. Zimmermann and Co. Ltd.; Swallowfield Aerosols Ltd.; Stafford Allen and Sons Ltd.; and Metropole Group of Industries.

A Works Removal

It has been announced by **J. B. Garnham and Sons Ltd.** that, as from Tuesday next, March 31, their works at Brimsdown, Middx., will be transferred to Lion Works, Cradley Heath, Staffs.

Investment Precision Casting

On another page of this journal, reference is made to the appointment of Mr. A. Dunlop as managing director of **Investril Casting and Metallurgical Services Ltd.**, a company which has been formed by Mr. Dunlop in conjunction with Mr. J. P. P. Jones to provide consultative facilities with particular reference to investment precision casting.

This company is the agent in this country and the British Commonwealth for the process patented by Mr. Nicholas Herzmark and known as the Plycast method of casting.

A Bearing Alloy

Over the past two years Alzen 305 bearing alloy has been used by engineers in many applications for plain bearings and slides. The alloy is now stated to be available in the form of bar and tube in the extruded and drawn condition.

It is understood that there are many advantages in producing the alloy in this form, the main ones being (a) the superior physical properties, in particular the increased ductility; (b) the closer dimensional tolerances obtainable; and (c) the surface finish.

This material is being processed in this country in the extruded and drawn state by Reynolds T.I. Aluminium Ltd., and is being marketed by the sub-licensees, **Hill Alzen Sales Ltd.** It should be noted that this material will be seen at the Engineering and Marine Exhibition, to be held next month at Olympia, on Stand No. 4, Row N, Ground Floor, National Hall. Technical staff of the company will be in attendance to answer enquiries.

Factory Equipment on Show

On Tuesday, April 7 next, the Factory Equipment Exhibition and Heat and Sound Insulation Exhibition will open at Earls Court, London, and will remain open until April 17.

In conjunction with this exhibition, a one-day conference on "Noise in Industry" will be held at Earls Court on Friday, April 10, commencing at 10.15 a.m., and will be opened by the Rt. Hon. Hilary A. Marquand, M.A., D.S., M.P. The purpose of this conference is to assist industrialists to understand the nature, causes and effects of harmful noise, and to inform them of the means available at this stage for dealing with the nuisance.

Philippine Copper Production

A total of 3,879,993 lb. of copper was produced during February by Atlas Consolidated Mining and Development Corporation. During the month, the company mill treated 335,598 tons of ore of an average grade of 0·68 per cent copper. Copper concentrates produced totalled 7,248 dry short tons, assaying 26·72 per cent copper and 0·125 ounces of gold per ton, and contained 3,879,993 lb. of copper and 906·1 ounces of gold.

The company's February output is slightly larger than the previous month's total, which was 3,548,499 lb. of copper from 6,442 dry short tons of copper concentrates. A total of 316,392 tons of ore was treated during January. Milling days of operation for February totalled 27. Shipments from the company's Toledo mine during February totalled 9,574 dry short tons of copper concentrates.

Agents for Oils and Greases

News from **Chas. H. Windschuegl Ltd.**, of London, is that they have been appointed sole agents in the United Kingdom for the "Beverol" motor and industrial oils and greases manufactured in Holland by Beverolfabrieken N.V. of Beverwijk.

A Poster Development

What appears to be a new development in British poster history is the news that aluminium foil posters have been printed and posted, having made their first "public appearance" in the Newcastle area last week. These posters are the product of the **Star Aluminium Co. Ltd**, of Wolverhampton.

An Exhibition and Convention

A new exhibition is planned to be held in October this year dealing with the **"Pneumatics and Hydraulics for Industry"** theme, and the venue will be the Alexandra Palace in North London. This exhibition will include facilities for outside demonstrations of equipment incorporating pneumatics and hydraulics.

During the period of the exhibition, a convention will be held at which speakers from this country, the Continent and the United States will discuss the latest developments in pneumatics and hydraulics relating to their particular industries. A further feature of the convention will be the inaugural meeting of the Fluid Power Association. The whole event is being organized by Macfarlane Watson Ltd.

Aluminium Castings

We are informed by **Alexander Cardew Limited** that they have recently come to an agreement with Fonderpress, of Bologna, to represent their die-making interests in this country. The Italian firm are producers of large high-quality aluminium castings.

Branch Office

As from the end of this month, the address of the Cambridge branch office of **British Insulated Callender's Cables Limited** will be 65 Devonshire Road, Cambridge. The telephone number remains as before—Cambridge 55451-2.

Spanish Zinc Plant

In reports from Cologne it is stated that, according to the builders, Kloeckner-Humboldt-Deutz A.G., the first stage of an electrolytic zinc plant being built in Cartagena, Spain, should be in operation by the end of the year.

When building operations are completed, the plant will have a daily capacity of 60 tons of electrolytic zinc of 99·99 per cent purity. Total cost will be 30 million marks. Should the necessity arise, the plant could be extended to double capacity.

Aluminium in Germany

West Germany's aluminium industry—with the notable exception of the primary producers—developed more favourably in 1958 than was anticipated at the beginning of that year, according to the board of Aluminiumwerke Nürnberg G.m.b.H. (Nüral). The firm said international statistics showed that world consumption of aluminium in 1958 had declined by around 3·7 per cent, mainly due to a reduction in industrial activity in several areas of the Western Hemisphere.

Despite an advance in the level of home consumption, West German output of aluminium declined by around 2·1 per cent, trends in the primary and secondary industries being directly opposed. Production of remelt alloys advanced very sharply, for instance, while that of primary aluminium dropped. There was no change in the overall capacity of the industry during 1958 at 165,000 metric tons. The total was split up into 120,000 tons for the Federally-owned Töging, Lünen and Grevenbroich refineries, and 45,000 tons for the Hütte Rheinfelden. No increase in output is planned for the current year because high costs of electric power and current trade conditions make it more economic to import the supplementary quantities required.

Nüral considered that the outlook for the West German industry this year was not unfavourable. The company said that the pressure of excess supplies of virgin aluminium would still be left on the

world's markets. However, with the slightly less favourable import conditions for foreign material, which came into effect at the turn of the year, and the reduction in the price of the domestic virgin metal, the company predicted that home capacity would be better employed, with a consequent increase in output. It also anticipated that demand from foundries and semi-manufacturing plants would increase.

Annual Meetings

Advance notice is given of the annual and general meetings of the **Association of Bronze and Brass Founders,** which are to be held at the Waldorf Hotel, Aldwych, London, W.C.2, on Wednesday, April 29 next.

New Forging Press

A 3,000 ton hydraulic forging press of two-column drawdown type is being designed by **Davy and United Engineering Company Limited** for installation in the Haywood Forge, at Halesowen, near Birmingham, of Walter Somers Ltd. The contract, valued at £84,000, covers all engineering design, the supply of 100 gal. gas-loaded hydraulic balance accumulator, and the provision of the three main crosshead castings, the combined weight of which is over 200 tons. In this particular instance, the actual manufacture of the press is being carried out by Walter Somers Ltd. themselves to Davy-United drawings.

As far as is known, this 3,000 ton press will be the largest drawdown press operating anywhere in the world. Design is being carried out in Davy-United's Glasgow works, and the press is scheduled to go into operation early in 1960.

Costing a Casting

In view of the interest created by the publication "Costing a Casting," issued by the **Association of Bronze and Brass Founders,** the association has decided to hold a further meeting at which practical advice will be given on installing and operating the system advocated. This will also provide an opportunity for questions on the system to be dealt with.

The meeting will be held at the Clarendon Restaurant, Hammersmith, London, W.6, on Wednesday, April 8 next, commencing at 6 p.m. Further details may be obtained from the secretaries, Heathcote and Coleman, at 69 Harborne Road, Edgbaston, Birmingham, 15.

Exhibiting at Amsterdam

An exhibit of particular interest at the forthcoming Europak Exhibition, to be held in Amsterdam next month, will be that provided by the European subsidiaries and associates of the **Aluminium Limited** group. The Northern Aluminium Company Ltd. will be represented by a display of foil stock, container sheet and coil, and slugs; also a wide range of containers, closures and tubes produced from them by the company's U.K. customers.

Non-Ferrous Club

Now in its fifth year, the **Non-Ferrous Club** held its annual general meeting at the Queen's Hotel, Birmingham, last week. Presenting his report for the year, Mr. Hugo McGhee, the chairman, said that membership now stood at 131, and throughout the year £161 16s. 0d. has been collected at the monthly luncheon meetings on behalf of various charities.

For the ensuing year, Mr. W. Demel was again persuaded to remain in office as the President of the club, and the following members were elected to the committee:—Mr. R. L. Deutsch, Mr. H. A. McGhee, Mr. W. H. Vizor, Mr. R. J. Freeman, and Mr. P. Mould.

Metal Powders

It is reported that a new B.S.A. subsidiary, **B.S.A. Metal Powders Ltd.,** has been formed to deal with the group's activities in the field of metal powders. It has become necessary to form this new company because the turnover on metal powders, which the group has been dealing in for some time now, has reached substantial proportions, and is likely to increase still further in the future.

The directors of the new company are Mr. A. D. Mackay, controller of the General Engineering Division, B.S.A.; Dr. J. F. Watkinson, the G.K.C. metallurgist who has been in charge of development; and Mr. F. Ellinghouse, secretary of the B.S.A. company.

It is understood that metal powders have for some time been produced at Small Heath, Birmingham, under the auspices of the B.S.A. Group Research Centre. Output has far exceeded the requirements of Metal and Plastic Components, for whom the powders were originally intended, but a ready market has been found outside the group. The powders are now being sold all over the world.

International Congress on Corrosion

A meeting, sponsored by the Society of Chemical Industry, is to be held at 14 Belgrave Square, London, S.W.1, at 3 p.m. on Monday, April 20 next, to consider a proposal that an International Congress on Corrosion be held in London in 1961. All persons interested in this proposal are invited to attend.

U.K. Metal Stocks

Stocks of refined tin in London Metal Exchange warehouses fell by 402 tons, and were distributed as follows at the end of last week: London 5,498 tons, Liverpool 4,648 tons, and Hull 1,190 tons.

Stocks of refined copper rose by 639 tons and were as follows: London 2,047 tons, Liverpool 4,194 tons, Birmingham 350 tons, and Manchester 2,625 tons.

An Appointment

News from **Crofts (Engineers) Ltd.** is that **Mr. R. W. Honeywell** has been appointed representative for the Leicester area of the company. An apprentice-trained and qualified engineer of long experience, Mr. Honeywell has recently completed a four months' training course at the company's main works at Thornbury, Bradford.

Informative Films

Of 1,500 films "acquired" during the past ten years for use in Britain's information services more than half have been obtained from industrial sources in this country, and over two-thirds are being used to help British industry at home and overseas.

This evidence of the part films are playing in industrial public relations, sales promotion, productivity promotion, training and welfare, was given on Friday last, when 200 representatives of industry and the press were invited by the Central Office of Information to see a programme marking the occasion of its 1,500th "acquisition."

In addition to producing films for the Government's information services, the C.O.I. views most of the short films produced in this country by other bodies and, in consultation with other government departments, considers whether they could be useful in helping the national effort. If it is thought that they can, approaches are made to the owners of the film and arrangements made to "acquire" the necessary rights.

Aluminium Exhibits

At the forthcoming Engineering, Marine, Welding and Nuclear Exhibition, which is being held next month at Olympia, London, an interesting exhibit is being provided by **The British Aluminium Company Ltd.** The company's range of products is represented by a selection of marine sections similar to those now being supplied to Harland and Wolff for the new P. and O. liner *Canberra,* together with sections for structural engineering, and a large display of P-G-P non-slip treadplate.

Applications of aluminium in chemical and petroleum engineering are illustrated with a scale model of the Whessoe Ltd. liquid methane tank for the North Thames Gas Board at Canvey Island, a 7 ft. 4 in. diameter hot spun flanged end, a range of oil pipelines with Victaulic couplings, and two heat exchangers.

The extensive railway engineering uses of aluminium are indicated by two cast aluminium railway carriage doors and a model of the passenger coaches recently built by the Malayan Railway. The welding of aluminium by inert-gas-shielded methods has recently been extended to thinner material than has been possible hitherto, by means of the experimental "pull-through" welding gun, which is seen, together with an example of its work.

Aluminium in U.S.A.

While there is room for optimism in the long-term future of aluminium, the industry faces a series of difficult problems in the period immediately ahead, according to a review by the Chase Manhattan Bank. The review says aluminium has been "one of the nation's most dynamic growth industries." During the past half-century, it has expanded at an average of 10 per cent per year—3½ times the growth rate of the general economy. However, this growth has not been smooth. Output multiplied 4½ times during World War II—from 206,000 tons in 1940 to 920,000 tons in 1943. At the end of the war, production was cut by more than 50 per cent.

The 1946-56 decade saw a phenomenal expansion of peacetime uses. In the past two years, however, capacity has expanded more rapidly than use. Production reached a new high in January, yet the industry operated at only 83 per cent of capacity. Moreover, capacity is slated to increase almost one-fifth by the end of 1960. Thus a rise in sales of nearly 40 per cent above the January level would be required for capacity operating by the end of next year. The industry, however, has "a record of aggressive and successful development of new markets." Prices are becoming competitive with other materials in more and more uses. The long-term growth potential remains impressive.

Metal Market News

LAST week was one of the most disastrous for copper seen for a very long time past, and at the close on Friday afternoon the tone was depressed and the outlook all in favour of a still lower price. Wall Street was a good deal "off the boil" and sentiment during the second half of the week far from good. On the other hand, the Stock Exchange here took on a cheerful appearance, industrials especially finding favour with the investing public. The crash in copper, for indeed it was hardly less than that, was said to have been started off by a rumour that there would be releases from the stockpile, but this was officially denied. However, there was a tremendous wave of liquidation on the New York commodity exchange, and on Wednesday and Thursday the combined turnover amounted to about 1,900 lots, the volume of business being said to be a record for any commodity market. The February statistics published by the Copper Institute in short tons, showed that stocks increased by about 5,000 tons in the U.S.A. and by 15,000 outside, this variation being rather less than had been expected. The British Bureau figures revealed that U.K. usage in January fell by 2,000 tons from December so that it was not a very good month. However, there were bull points that gave the market a good start, as witness the strike at the Smelting Company's Tacoma plant and the threat of a possible railway strike in Rhodesia. Stocks of copper in L.M.E. warehouses were up by 510 tons to 8,577 tons, and it looks as if this trend may continue, unless, of course, copper is going to be shipped to the States.

Early in the week the custom smelters, who had withdrawn from the market at 32 cents, reappeared as sellers at 34 cents, while dealers and merchants were said to be holding out for 35 cents. It almost seemed as if this were the signal for our market in London to crack, for it was on Wednesday that the rot set in. The top of the long rise occurred on Tuesday last week, when cash stood at £257 15s. 0d. and three months at £255 15s. 0d., but from this level a decline was seen, gathering momentum as it went, and finishing up eventually at £244 10s. 0d. cash and £243 5s. 0d. three months on a turnover of 12,275 tons. The Kerb was active, with a larger volume of trading than usual during the week. On Friday afternoon the Kerb was reported as weak, with the quotation down by about 15s. Needless to say, demand by the consumers was very poor in the face of such a severe setback in the price, and confidence was very much shaken. The quotation on the U.S. futures market declined severely and, as already mentioned, business was on a record-breaking scale, dealing being delayed sometimes by the huge number of selling orders piling up for execution.

From the highest point reached during the week the cash price declined by £13, but in comparison with the previous Friday the prompt quotation lost £7 5s. 0d. and forward £7 15s. 0d. The backwardation has shown some signs of contracting, and with stocks rising this tendency should continue. As we write, the custom smelters' price remains at 34 cents, but a reduction seems to be inevitable very soon. For the moment, confidence in copper appears completely to have evaporated. The other metals were all steady. Tin, on a turnover of 480 tons, gained 10s. for both positions, with no special feature. Lead was quiet, only 3,000 tons changing hands, March losing 17s. 6d. and June 22s. 6d. on balance. Trading in zinc, too, was on a smaller scale than in the previous week, for some 4,600 tons changed hands with a drop of 15s. in prompt and of 5s. in forward metal. Stocks of tin in L.M.E. warehouses dropped by 444 tons to 11,738 tons.

Paris

Demand revived slightly this week on the local scrap market after weeks of lethargy. Buyers have to re-enter the market to replenish their stocks, and this imparted a firmer tone to most non-ferrous scrap metals. Aluminium benefited most, but copper and zinc also gained some ground.

Birmingham

The most encouraging feature reported to the monthly meeting of the Midland Regional Board for Industry is that the downward trend in unemployment continues, and has been accompanied by a marked decrease in short-time working. Apart from this, there is little significant change in the general position amongst users of non-ferrous metal, and the usual hesitation in placing orders in the period immediately preceding the Budget is evident amongst consumers. The motor trade continues to provide a considerable amount of work, not only in the assembly shops but in the works manufacturing components, and some of the car manufacturers are already forecasting a record season for sales. Although the outlook for machine tools is brighter, most firms have smaller order books than they had a year ago. A good trade is being done amongst makers of heavy electrical equipment. The improvement in the building trade, particularly in regard to housing contracts is maintained.

Makers of heavy constructional steel could handle considerably more business in heavy joists and sections. Demand for heavy plates remains steady, and there are good sales for material required for tank and boiler making. The market for pig iron is brisk as far as producers of heavy castings are concerned, but there is still a good deal of unemployment amongst the numerous small iron foundries in the Black Country. Re-rolling works are operating on a short-time basis.

New York

Continued easiness on the London Metals Exchange and of copper futures and scrap copper here, produced a reversal in custom smelter business last week-end. Custom smelters reported continued good business at 34 cents, but later they indicated consumer interest had fallen off sharply. Scrap copper was off at least a quarter of a cent a lb., with renewed softness showing itself again in the late afternoon. Offerings were quite heavy. With custom smelters intake of scrap heavy, and sales of electrolytic lagging, traders looked for a price reduction in the custom smelter copper price to develop next week. Meanwhile, conditions were unchanged in producer copper, with producers pressed for supplies by consumers. However, the producer price remains at 31½ cents, compared to custom smelter price of 34 cents, and the dealer domestic price is somewhat lower than 34 cents a lb. Copper futures were erratic, but easy latterly on renewed profit-taking and stop loss selling, with dealings active.

Tin was quiet and softer. Lead and zinc continued quiet.

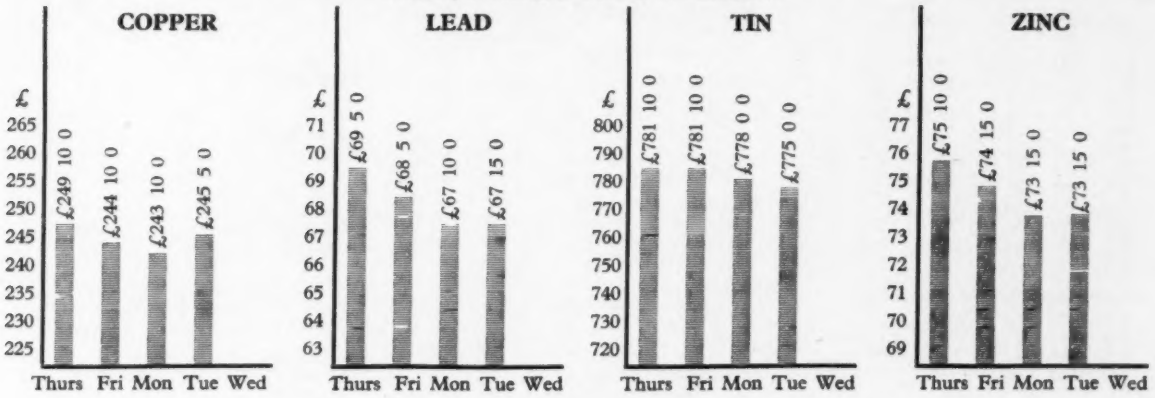
Receipts of purchased copper-base scrap at brass mills in the United States in January reversed the upward trend of the previous five months and dropped 22 per cent from December to 29,502 short tons, according to the Bureau of Mines, United States Department of the Interior. Total scrap consumption, including home scrap, on the other hand, was slightly more than in December, at 84,185 tons. Consumption of refined copper at brass mills rose 5 per cent in January to 50,912 tons, whereas that at wire mills declined 5 per cent to 69,188 tons; stocks of refined copper were 5 per cent less at brass mills (49,082 tons) but increased 4 per cent at wire mills (38,508 tons).

Recovery of secondary zinc in zinc-base products in the United States during December increased 11,100 short tons, according to the Bureau of Mines, United States Department of the Interior. Total stocks of all types of zinc scrap increased 10 per cent to 41,600 tons, the highest monthly level since November, 1944. Consumption of zinc scrap totalled 15,700 tons, 4 per cent over November. New clippings showed the largest percentage increase (72 per cent), and rod and die scrap the largest percentage decrease (42 per cent).

Non-Ferrous Metal Prices

London Metal Exchange

Thursday 19 March to Tuesday 24 March 1959



Primary Metals

All prices quoted are those available at 2 p.m. 24/3/59

		£	s.	d.
Aluminium Ingots	ton	180	0	0
Antimony 99·6%	„	197	0	0
Antimony Metal 99%	„	190	0	0
Antimony Oxide	„	180	0	0
Antimony Sulphide Lump	„	190	0	0
Antimony Sulphide Black Powder	„	205	0	0
Arsenic	„	400	0	0
Bismuth 99·95%	lb.		16	0
Cadmium 99·9%	„		9	0
Calcium	„	2	0	0
Cerium 99%	„	16	0	0
Chromium	„		6	11
Cobalt	„		14	0
Columbite per unit			—	
Copper H.C. Electro	ton	245	5	0
Fire Refined 99·70%	„	244	0	0
Fire Refined 99·50%	„	243	0	0

		£	s.	d.
Copper Sulphate	ton	78	0	0
Germanium	grm.		—	
Gold	oz.	12	9	2
Indium	„		10	0
Iridium	„	24	0	0
Lanthanum	grm.		15	0
Lead English	ton	67	15	0
Magnesium Ingots	lb.		2	3
Notched Bar	„		2	9½
Powder Grade 4	„		6	1
Alloy Ingot, A8 or AZ91	„		2	4
Manganese Metal	ton	245	0	0
Mercury	flask	75	0	0
Molybdenum	lb.	1	10	0
Nickel	ton	600	0	0
F. Shot	lb.		5	5
F. Ingot	„		5	6
Osmium	oz.		nom.	
Osmiridium	„		nom.	

		£	s.	d.
Palladium	oz.	5	15	0
Platinum	„	28	10	0
Rhodium	„	40	0	0
Ruthenium	„	14	0	0
Selenium	lb.		nom.	
Silicon 98%	ton		nom.	
Silver Spot Bars	oz.		6	7½
Tellurium	lb.		15	0
Tin	ton	775	0	0
***Zinc**				
Electrolytic	ton		—	
Min 99·99%	„		—	
Virgin Min 98%	„	73	8	1½
Dust 95/97%	„	109	0	0
Dust 98/99%	„	115	0	0
Granulated 99+%	„	98	8	1½
Granulated 99·99+%	„	111	12	6

**Duty and Carriage to customers' works for buyers' account.*

Foreign Quotations

Latest available quotations for non-ferrous metals with approximate sterling equivalents based on current exchange rates

	Belgium fr/kg ≏ £/ton	**Canada** c/lb ≏ £/ton	**France** fr/kg ≏ £/ton	**Italy** lire/kg ≏ £/ton	**Switzerland** fr/kg ≏ £/ton	**United States** c/lb ≏ £/ton
Aluminium		22.50 185 17 6	210 157 10	375 221 5	2.50 212 10	26.80 214 10
Antimony 99.0			220 165 0	445 262 10		29.00 232 0
Cadmium			1,350 1,012 10			145.00 1,160 0
Copper						
Crude						
Wire bars 99.9				490 289 2 6		
Electrolytic	34.25 252 0	30.50 252 0	353 264 15		3.05 295 5 0	31.50 252 0
Lead		10.50 86 15	103 77 5	166 98 0 0	.87 74 0	11.50 92 0
Magnesium						
Nickel		70.00 578 5	900 675 0	1,200 708 0	7.50 637 10	74.00 592 0
Tin	113.00 831 12 6		1,110 832 10	1,520 896 17 6	9.60 816 0	103.00 824 0
Zinc						
Prime western		11.25 93 0 0				11.00 88 0
High grade 99.95		11.85 97 17 6				
High grade 99.99		12.25 101 2 6				
Thermic			111.00 83 5			
Electrolytic			119.00 89 5	172 101 10	.99 84 2 6	12.25 98 0

Non-Ferrous Metal Prices (continued)

Ingot Metals

All prices quoted are those available at 2 p.m. 24/3/59

		£	s.	d.
Aluminium Alloy (Virgin)				
B.S. 1490 L.M.5	ton	210	0	0
B.S. 1490 L.M.6	„	202	0	0
B.S. 1490 L.M.7	„	216	0	0
B.S. 1490 L.M.8	„	203	0	0
B.S. 1490 L.M.9	„	203	0	0
B.S. 1490 L.M.10	„	221	0	0
B.S. 1490 L.M.11	„	215	0	0
B.S. 1490 L.M.12	„	223	0	0
B.S. 1490 L.M.13	„	216	0	0
B.S. 1490 L.M.14	„	224	0	0
B.S. 1490 L.M.15	„	210	0	0
B.S. 1490 L.M.16	„	206	0	0
B.S. 1490 L.M.18	„	203	0	0
B.S. 1490 L.M.22	„	210	0	0
†Aluminium Alloys (Secondary)				
B.S. 1490 L.M.1	ton		—	
B.S. 1490 L.M.2	„		—	
B.S. 1490 L.M.4	„		—	
B.S. 1490 L.M.6	„		—	
***Aluminium Bronze**				
BSS 1400 AB.1	ton	240	0	0
BSS 1400 AB.2	„	258	0	0

		£	s.	d.
***Brass**				
BSS 1400-B3 65/35	ton	162	0	0
BSS 249	„		—	
BSS 1400-B6 85/15	„	200	0	0
***Gunmetal**				
R.C.H. 3/4%	ton		—	
(85/5/5/5)	„	203	0	0
(86/7/5/2)	„	212	0	0
(88/10/2/1)	„	250	0	0
(88/10/2/½)	„	267	0	0
***Manganese Bronze**				
BSS 1400 HTB1	„	201	0	0
BSS 1400 HTB2	„		—	
BSS 1400 HTB3	„	216	0	0
Nickel Silver				
Casting Quality 12%	„	225	0	0
„ „ 16%	„	235	0	0
„ „ 18%	„	245	0	0
***Phosphor Bronze**				
B.S. 1400 P.B.1. (A.I.D. released)	„	296	0	0
B.S. 1400 L.P.B.1	„	217	0	0

**Average prices for the last week-end.*

		£	s.	d.
Phosphor Copper				
10%	ton	262	0	0
15%	„	271	0	0
Phosphor Tin				
5%	„		—	
Silicon Bronze				
BSS 1400-SB1	„	262	0	0
Solder, soft, BSS 219				
Grade C Tinmans	„	361	6	0
Grade D Plumbers	„	290	6	0
Grade M	„	397	3	0
Solder, Brazing, BSS 1845				
Type 8 (Granulated)	lb.		—	
Type 9 „	„		—	
Zinc Alloys				
Mazak III	ton	104	17	6
Mazak V	„	108	17	6
Kayem	„	114	17	6
Kayem II	„	120	17	6
Sodium-Zinc	lb.		2	6

Semi-Fabricated Products

Prices vary according to dimensions and quantities. The following are the basis prices for certain specific products.

		£	s.	d.
Aluminium				
Sheet 10 S.W.G.	lb.		2	8½
Sheet 18 S.W.G.	„		2	10½
Sheet 24 S.W.G.	„		3	1½
Strip 10 S.W.G.	„		2	8½
Strip 18 S.W.G.	„		2	9½
Strip 24 S.W.G.	„		2	11
Circles 22 S.W.G.	„		3	2½
Circles 18 S.W.G.	„		3	1½
Circles 12 S.W.G.	„		3	0½
Plate as rolled	„		2	8
Sections	„		3	2
Wire 10 S.W.G.	„		2	11½
Tubes 1 in. o.d. 16 S.W.G.	„		4	1
Aluminium Alloys				
BS1470. HS10W.				
Sheet 10 S.W.G.	„		3	1
Sheet 18 S.W.G.	„		3	3½
Sheet 24 S.W.G.	„		3	11
Strip 10 S.W.G.	„		3	1
Strip 18 S.W.G.	„		3	2½
Strip 24 S.W.G.	„		3	10½
BS1477. HP30M.				
Plate as rolled	„		2	11
BS1470. HC15WP.				
Sheet 10 S.W.G.	„		3	9½
Sheet 18 S.W.G.	„		4	2
Sheet 24 S.W.G.	„		5	0½
Strip 10 S.W.G.	„		3	10½
Strip 18 S.W.G.	„		4	2
Strip 24 S.W.G.	„		4	9½
BS1477. HPC15WP.				
Plate heat treated	„		3	6½
BS1475. HG10W.				
Wire 10 S.W.G.	„		3	10½
BS1471. HT10WP.				
Tubes 1 in. o.d. 16 S.W.G.	„		5	0½
BS1476. HE10WP.				
Sections	„		3	1½
Brass				
Tubes	„		1	11½
Brazed Tubes	„		—	
Drawn Strip Sections	„		—	
Sheet	ton		—	
Strip	„	260	5	0
Extruded Bar	lb.		2	0½
Extruded Bar (Pure Metal Basis)	„		—	

		£	s.	d.
Brass				
Condenser Plate (Yellow Metal)	ton	195	0	0
Condenser Plate (Naval Brass)	„	207	0	0
Wire	lb.		2	8½
Beryllium Copper				
Strip	„	1	4	11
Rod	„	1	1	6
Wire	„	1	4	9
Copper				
Tubes	lb.		2	4½
Sheet	ton	276	5	0
Strip	„	276	5	0
Plain Plates	„		—	
Locomotive Rods	„		—	
H.C. Wire	„	296	15	0
Cupro Nickel				
Tubes 70/30	lb.		3	7½

		£	s.	d.
Lead				
Pipes (London)	ton	112	5	0
Sheet (London)	„	110	0	0
Tellurium Lead	„	£6 extra		
Nickel Silver				
Sheet and Strip 7%	lb.		3	9½
Wire 10%	„		4	4
Phosphor Bronze				
Wire	„		4	2½
Titanium (1,000 lb. lots)				
Billet over 4″ dia.-18″ dia.	lb.	63/-		64/-
Rod 4″ dia.-·250″ dia.	„	75/-		112/-
Wire under ·250″ dia.-·036″ dia.	„	146/-		222/-
Sheet 8′ × 2′ × ·250″-·010″	„	88/-		157/-
Strip ·048″-·003″	„	100/-		350/-
Tube	„			300/-
Extrusions	„			120/-
Zinc				
Sheet	ton	111	0	0
Strip	„		nom.	

Domestic and Foreign

Merchants' average buying prices delivered, per ton, 24/3/59.

	£
Aluminium	
New Cuttings	145
Old Rolled	125
Segregated Turnings	96
Brass	
Cuttings	168
Rod Ends	148
Heavy Yellow	130
Light	125
Rolled	158
Collected Scrap	128
Turnings	141
Copper	
Wire	220
Firebox, cut up	213
Heavy	210
Light	205
Cuttings	220
Turnings	200
Braziery	168

	£
Gunmetal	
Gear Wheels	192
Admiralty	192
Commercial	170
Turnings	165
Lead	
Scrap	59
Nickel	
Cuttings	—
Anodes	550
Phosphor Bronze	
Scrap	170
Turnings	165
Zinc	
Remelted	58
Cuttings	53
Old Zinc	37

Metal Statistics

Detailed figures of the consumption and output of non-ferrous metals for the month of Jan., 1959, have been issued by the British Bureau of Non-Ferrous Metal Statistics, as follow in long tons:—

COPPER	Gross Weight	Copper Content
Wire	22,094	21,711
Rods, bars and sections	12,574	8,295
Sheet, strips and plate	14,788	11,295
Tubes	7,251	6,675
Castings and miscellaneous	6,760	—
Sulphate	3,523	—
	66,990	54,395
Of which:		
Consumption of Virgin Copper		39,815
Consumption of Copper and Alloy Scrap (Copper Content)		14,580

LEAD	
Cables	9,044
Batteries	2,272
Battery Oxides	2,050
Tetra Ethyl Lead	2,022
Other Oxides and Compounds	1,967
White Lead	760
Shot	360
Sheet and Pipe	5,818
Foil and Collapsible Tubes	272
Other Rolled and Extruded	472
Solder	1,141
Alloys	1,556
Miscellaneous Uses	1,138
Total	28,887

TIN	
Tinplate	837
Tinning:	
Copper Wire	53
Steel Wire	8
All other	68
Solder	193
Alloys	456
Foil and Collapsible Tubes, etc.	51
Tin Compounds, Salts, and Miscellaneous Uses	103
Total Consumption	1,769

ZINC	
Galvanizing	7,935
Brass	9,520
Rolled Zinc	2,107
Zinc Oxide	2,393
Zinc Die-casting alloy	3,669
Zinc Dust	907
Miscellaneous Uses	958
Total, All Trades	27,489
Of which:	
High purity 99·99 per cent	4,036
Electrolytic and high grade 99·95 per cent	4,969
Prime Western, G.O.B. and de-based	9,961
Remelted	522
Scrap Brass and other Cu alloys	5,019
Scrap Zinc, alloys and residues	2,771

ANTIMONY	
Batteries	89
Other Antimonial Lead	36
Bearings	28
Oxides—for White Pigments	106
Oxides—other	100
Miscellaneous Uses	18
Sulphides	7
Total Consumption	384
Antimony in Scrap	
For Antimonial Lead	316
For Other Uses	15
Total Consumption	331

CADMIUM	
Plating Anodes	47·70
Plating Salts	12·90
Alloys: Cadmium Copper	8·95
Alloys: Other	2·60
Batteries: Alkaline	8·35
Batteries: Dry	0·35
Solder	6·25
Colours	21·05
Miscellaneous Uses	2·05
Total Consumption	110·20

Scrap Metal Prices

The figures in brackets give the English equivalents in £1 per ton:—

West Germany (D-marks per 100 kilos):		
Used copper wire	(£205.17.6)	235
Heavy copper	(£205.17.6)	235
Light copper	(£170.17.6)	195
Heavy brass	(£113.17.6)	130
Light brass	(£92.0.0)	105
Soft lead scrap	(£57.0.0)	65
Zinc scrap	(£39.10.0)	45
Used aluminium unsorted	(£78.16.0)	90
France (francs per kilo):		
Electrolytic copper scrap	(£198.15.0)	265
Heavy copper	(£198.15.0)	265
No. 1 copper wire	—	—
Light brass	(£116.5.0)	155
Zinc castings	(£49.10.0)	66
Lead	(£67.10.0)	90
Aluminium	(£120.0.0)	160
Italy (lire per kilo):		
Aluminium soft sheet clippings (new)	(£197.12.6)	335
Aluminium copper alloy	(£126.17.6)	215
Lead, soft, first quality	(£79.0.0)	134
Lead, battery plates	(£43.12.6)	74
Copper, first grade	(£227.2.6)	385
Copper, second grade	(£215.7.6)	365
Bronze, first quality machinery	(£212.10.0)	360
Bronze, commercial gunmetal	(£183.0.0)	310
Brass, heavy	(£147.10.0)	250
Brass, light	(£132.15.0)	225
Brass, bar turnings	(£135.15.0)	230
New zinc sheet clippings	(£57.5.0)	97
Old zinc	(£42.10.0)	72

Financial News

Glynwed Tubes

Group profits for the past year are shown at £977,225, against £1,078,438 for the previous year. After deduction of tax, net profit remains at £450,344, against £487,658 in 1957. A final dividend of 10 per cent brings the dividend for the year to 20 per cent (same).

George Edmonds Ltd.

Group net profit, 1958, £5,819 (£9,714), no final dividend (10 per cent), interim 5 per cent (7½ per cent), but special interim 7½ per cent. Current assets £127,516 (£141,622), liabilities £24,353 (£36,129).

Enfield Rolling Mills

Consolidated trading profit £1,879,567 (£1,749,990). After tax and depreciation, net profit is £737,725 (£632,750). Unappropriated profit from 1957 of £130,945 has been transferred to revenue reserve. Final dividend recommended is 12½ per cent, making 15 per cent for the year (against 12½ per cent).

Fescol Ltd.

Trading profit, etc., 1958, is £86,080 (£77,420) and taxed net profit £17,468 (£13,672). To reserves £9,500 (£5,000), Ordinary dividend 10 per cent (7½ per cent). Forward £33,308 (£33,299). Current assets £197,484 (£170,067), liabilities £66,545 (£66,432).

Delta Metal Ltd.

Group profit for the year £2,114,909 (£1,533,107), before taxation. A final dividend of 15 per cent and a bonus of 6 per cent are recommended. It is also proposed to make a one-for-one scrip issue.

Trade Publications

Hollow Bored Bars.—Keeton, Sons and Co. Ltd., Keeton Works, Greenland Road, Sheffield, 9.

The normal range of hollow bored bars produced by this company has been extended to include bore diameters up to 6½ in. in bars up to 10¼ in. o.d. The maximum length in the normal range is now 18 ft. A useful 12-page brochure has been published giving details of these bars with diagrams, statistical data and illustrations. In addition to their range of hollow bored bars, the company—a member of the Firth Cleveland group—manufacture Keetona machine tools for the sheet metalworking industry.

Aluminium Rainwater Goods. — The Aluminium Development Association, 33 Grosvenor Street, London, W.1.

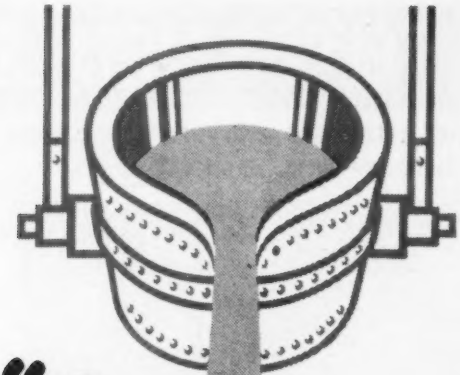
This brochure is one of the latest in the association's series of applications brochures, and is intended for architects, surveyors, local authorities, estate agents, property owners, contractors, etc. The brochure reviews various installations and outlines those properties of aluminium that make it a most suitable material for use in a wide range of rainwater goods. The principal section of the brochure deals with dimensions of the main types of gutters—half round, ogee and rectangular; also with the associated fittings and accessories. Rainwater pipes and fittings are similarly treated.

THE STOCK EXCHANGE

Good Demand Continued In Evidence

ISSUED CAPITAL •	AMOUNT OF SHARE	NAME OF COMPANY	MIDDLE PRICE 23 MARCH	+RISE—FALL	DIV. FOR LAST FIN. YEAR	DIV. FOR PREV. YEAR	DIV. YIELD	1959 HIGH	1959 LOW	1958 HIGH	1958 LOW
£	£				Per cent	Per cent					
4,435,792	1	Amalgamated Metal Corporation ...	24/4½		9	10	7 10 0	24/10½	23/3	24/9	17/6
400,000	2/–	Anti-Attrition Metal	1/6		4	8½	5 6 9	—	—	1/9	1/3
41,305,038	Stk. (£1)	Associated Electrical Industries ...	55/–xd		15	15	5 7 9	59/–	54/–	58/9	46/6
1,609,032	1	Birfield	48/–	—1/–	15	15	6 5 0	59/–	48/–	62/4½	46/3
3,196,667	1	Birmid Industries	73/6	+3d.	17½	17½	4 15 3	76/10½	72/–	77/6	55/3
5,630,344	Stk. (£1)	Birmingham Small Arms	37/–		11	10	5 19 0	40/4½	36/1½	39/–	23/9
203,150	Stk. (£1)	Ditto Cum. A. Pref. 5%	16/3		5	5	6 3 0	16/3	15/–	16/1½	14/7½
350,580	Stk. (£1)	Ditto Cum. B. Pref. 6%	17/9		6	6	6 15 3	18/1½	17/9	17/4½	16/6
500,000	1	Bolton (Thos.) & Sons	28/–		10	12½	7 2 9	28/3	27/6	28/9	24/–
300,000	1	Ditto Pref. 5%	15/6		5	5	6 9 0	15/6	15/–	16/–	15/–
160,000	1	Booth (James) & Co. Cum. Pref. 7%	20/6		7	7	6 16 6	—	—	20/4½	19/–
1,500,000	Stk. (£1)	British Aluminium Co. Pref. 6% ...	19/6		6	6	6 3 0	19/7½	18/9	20/–	18/4½
15,000,000	Stk. (£1)	British Insulated Callender's Cables	48/3	—6d.	12½	12½	5 3 6	53/–	47/6	52/6	38/9
17,047,166	Stk. (£1)	British Oxygen Co. Ltd., Ord. ...	55/3	—9d.	10	10	3 12 6	56/–	49/3	52/–	28/3
600,000	Stk. (5/–)	Canning (W.) & Co.	25/4½		25+ *2½C	25	4 18 6	25/6	24/9	25/3	19/3
60,484	1/–	Carr (Chas.)	2/–	+7½d.	12½	25	6 5 0	2/–	1/3	2/3	1/4½
150,000	2/–	Case (Alfred) & Co. Ltd.	5/1½	+1½d.	25	25	10 0 0	5/3	4/7½	5/3	4/–
555,000	1	Clifford (Chas.) Ltd.	22/10½		10	10	8 15 0	22/10½	22/6	22/–	16/–
45,000	1	Ditto Cum. Pref. 6%	15/3		6	6	7 17 6	—	—	16/–	15/–
250,000	2/–	Coley Metals	3/–		20	25	13 6 9	3/3	2/10½	4/6	2/6
8,730,596	1	Cons. Zinc Corp.†	61/9	+9d.	18‡	22½	6 3 0	67/6	60/6	65/3	41/–
1,509,528	1	Davy & United	93/6	+6d.	20	15	4 5 6	96/–	86/–	87/–	45/9
2,915,000	5/–	Delta Metal	29/3	+1/3	31	30	5 6 0	29/3	24/1½	25/–	17/7½
4,600,000	Stk. (£1)	Enfield Rolling Mills Ltd.	48/–	+1/–	15	12½	6 5 0	48/–	36/7½	38/–	22/9
750,000	1	Evered & Co.	30/9xd		10§	15 Z	6 10 0	31/3	30/–	30/–	26/
18,000,000	Stk. (£1)	General Electric Co.	31/6	+6d.	10P	12½		40/3	30/9	40/6	29/6
1,500,000	Stk. (10/–)	General Refractories Ltd.	35/–	—6d.	20	20	5 14 3	40/–	35/–	39/3	27/3
401,240	1	Gibbons (Dudley) Ltd.	64/–		15	15	4 13 6	66/6	64/–	67/6	61/–
750,000	5/–	Glacier Metal Co. Ltd.	6/9		11½	11½	8 10 3	7/1½	6/7½	8/3	5/–
1,750,000	5/–	Glynwed Tubes	18/3	+1/–	20	20	5 9 6	19/3	16/4½	18/1½	12/10½
5,421,049	10/–	Goodlass Wall & Lead Industries ...	31/–		13‖	18Z	4 4 0	31/6	28/7½	30/9	17/3
342,195	1	Greenwood & Batley	79/6	—1/6	20	17½	5 0 6	83/9	75/–	57/9	45/–
396,000	5/–	Harrison (B'ham) Ord.	15/–		*15	*15	5 0 0	15/3	14/11½	15/9	11/6
150,000	1	Ditto Cum. Pref. 7%	19/6		7	7	7 3 6	—	—	19/9	18/4½
1,075,167	5/–	Heenan Group	8/–		10	10‡	6 5 0	8/3	7/6	9/7½	6/9
236,958,260	Stk. (£1)	Imperial Chemical Industries ...	34/10½		12Z	10	4 11 9	38/3	33/9	38/–	24/3
34,736,773	Stk. (£1)	Ditto Cum. Pref. 5%	16/6		5	5	6 1 3	16/10½	16/–	17/1½	16/–
14,584,025	**	International Nickel	168½	—2½	$2.60	$3.75	2 15 3	171	153	169	132‡
860,000	5/–	Jenks (E. P.), Ltd.	9/3		14	27½φ	7 11 3	10/–	8/9	10/–	6/7½
300,000	1	Johnson, Matthey & Co. Cum. Pref. 5%	16/3		5	5	6 3 0	16/3	15/4½	16/9	15/–
3,987,435	1	Ditto Ord.	48/9	—9d.	10	10	4 2 0	52/6	44/3	47/–	36/6
600,000	10/–	Keith, Blackman	27/6		17½E	15	6 7 3	27/6	25/–	28/9	15/–
320,000	4/–	London Aluminium	6/3	+4½d.	10	10	6 8 0	6/3	5/3	6/–	3/–
765,012	1	McKechnie Brothers Ord.	42/6		15	15	7 1 3	45/–	42/6	45/–	32/–
1,530,024	1	Ditto A Ord.	40/–		15	15	7 10 0	43/6	40/–	45/–	30/–
1,108,268	5/–	Manganese Bronze & Brass	15/6		20	27½‡	6 9 0	15/6	13/9	14/1½	8/9
50,628	6/–	Ditto (7½% N.C. Pref.)	6/–		7½	7½	7 10 0	—	—	6/3	5/6
13,098,855	Stk (£1)	Metal Box	78/–	+6d.	11	11	2 16 6	78/–	66/6	73/3	40/6
415,760	Stk. (2/–)	Metal Traders	9/6	+6d.	50	50	10 10 6	9/6	8/4½	9/–	6/3
160,000	1	Mint (The) Birmingham	22/9		10	10	8 15 9	22/9	22/–	22/9	19/–
80,000	5	Ditto Pref. 6%	72/6		6	6	8 5 6	75/6	69/–	83/6	69/–
3,705,670	Stk. (£1)	Morgan Crucible A	44/6		10	10	4 10 0	45/9	43/6	45/–	34/–
1,000,000	Stk. (£1)	Ditto 5½% Cum. 1st Pref. ...	17/6		5½	5½	6 5 9	18/6	17/6	18/–	17/–
2,200,000	Stk. (£1)	Murex	48/–	—1/–	17½	20	7 5 9	49/6	42/–	58/9	46/–
468,000	5/–	Ratcliffs (Great Bridge)	10/4½		10R	10	4 16 6	11/3	10/4½	11/1½	6/10½
234,960	10/–	Sanderson Bros. & Newbould ...	28/9		20	27½D	6 19 3	28/9	27/9	27/3	24/6
1,365,000	Stk. (5/–)	Sarck	19/–	+9d.	15	17½	3 19 0	19/–	18/–	18/7½	11/–
6,698,586	Stk. (£1)	Stone-Platt Industries	44/6		15	12½	6 14 9	46/9	43/3	45/6	22/6
2,928,963	Stk. (£1)	Ditto 5½% Cum. Pref.	16/1½		5½	5½	6 16 6	16/7½	15/10½	16/3	12/7½
18,255,218	Stk. (£1)	Tube Investments Ord.	83/–	+3/–	17½	15	4 4 3	83/3	72/–	86/–	48/4½
41,000,000	Stk. (£1)	Vickers	31/10½	+1½d.	10	10	6 5 6	37/–	30/6	36/3	28/9
750,000	Stk. (£1)	Ditto Pref. 5%	14/9		5	5	6 15 6	15/0½	14/7½	15/9	14/3
6,863,807	Stk. (£1)	Ditto Pref. 5% tax free	21/6		*5	*5	7 3 6A	22/7½	21/7½	23/–	21/3
2,200,000	1	Ward (Thos. W.), Ord.	84/–	+3d.	20	15	4 15 3	87/6	83/6	87/3	70/9
2,666,034	Stk. (£1)	Westinghouse Brake	43/–	—3d.	10	10	4 13 0	47/–	39/9	46/6	32/6
225,000	2/–	Wolverhampton Die-Casting ...	10/3	+1/3	30	25	5 17 0	10/3	8/8½	10/1½	7/–
591,000	5/–	Wolverhampton Metal	22/9		27½	27½	6 0 9	23/–	21/6	22/9	14/9
78,465	2/6	Wright, Bindley & Gell	6/7½	+6d.	20	20	7 11 0	6/7½	4/11½	5/4½	2/9
124,140	1	Ditto Cum. Pref. 6%	13/7½	+1½d.	6	6	8 16 3	13/7½	13/6	13/–	11/3
150,000	1/–	Zinc Alloy Rust Proof	3/–		27	40D	9 0 0	3/–	2/9	3/1½	2/7½

•Dividend paid free of Income Tax. †Incorporating Zinc Corpn. & Imperial Smelting ••Shares of no Par Value. ‡ and 100% Capitalized Issue. ●The figures given relate to the issue quoted in the third column. A Calculated on £7 14 6 gross. Y Calculated on 11½% dividend. ‖Adjusted to allow for capitalization issue. E for 15 months. D and 50% capitalized issue. Z and 50% capitalized issue. B equivalent to 12½% on existing Ordinary Capital after 100% capitalized issue. φ And 100% capitalized issue. X Calculated on 17½%. C Paid out of Capital Profits. E and 50% capitalized issue in 7% 2nd Pref. Shares. P Interim dividend since reduced. § And Special distribution of 2½% free of tax. R And proposed 33⅓% capitalized issue in 8% Maximum Ordinary 5/– Stock Units.



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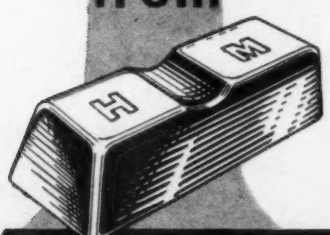
for
COMPETITIVE PRICES
and first class
QUALITY
order your ingots from



HENEAGE METALS LTD.

INGOTS IN GUNMETAL · PHOSPHOR BRONZE AND BRASS

HENEAGE METALS LTD. HENEAGE ST. BIRMINGHAM
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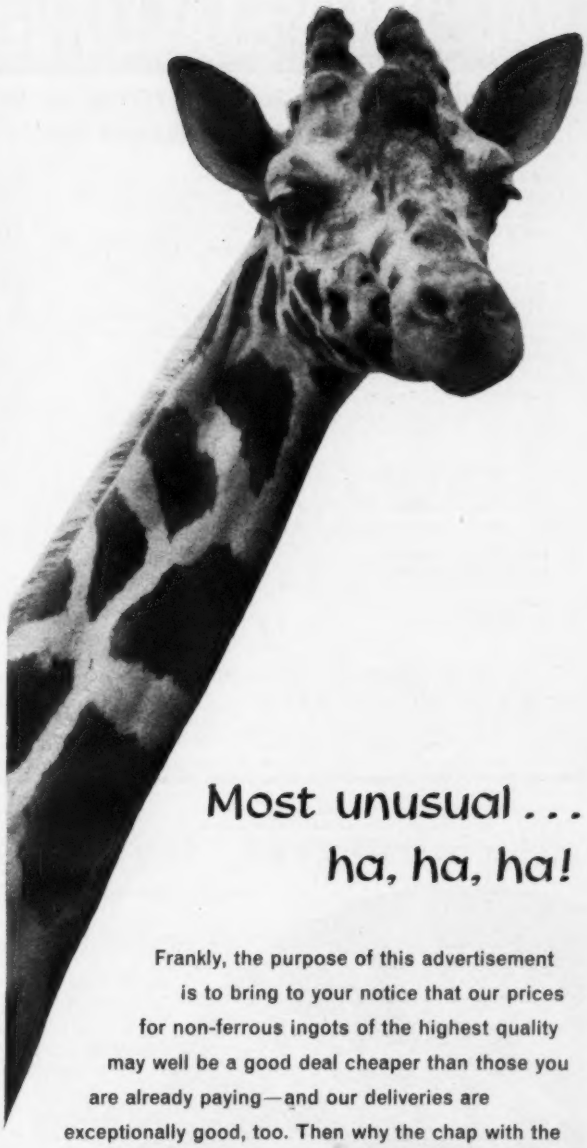

Most unusual . . .
ha, ha, ha!

Frankly, the purpose of this advertisement is to bring to your notice that our prices for non-ferrous ingots of the highest quality may well be a good deal cheaper than those you are already paying—and our deliveries are exceptionally good, too. Then why the chap with the camouflaged neck? Well, we rather thought that at first sight you might be more interested in him than in us. But now we have come this far together, may we send you particulars of our production facilities and details of our very keen prices?

Gold Medal Brussels World Exhibition 1958 The Engineering Centre Collective Exhibit

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METALS LTD

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E

VACUUM METALLURGY *by* TELCON METALS

SUPER PURE BASIC METALS & ALLOYS FOR THE INSTRUMENT, ELECTRONIC & AIRCRAFT INDUSTRIES, NICKEL, COPPER, IRON, MANGANESE COPPER, BERYLLIUM COPPER & MAGNETIC ALLOYS

SOFT MAGNETIC ALLOYS
High permeability Nickel Iron Alloys for cores and laminations.

MUMETAL
SUPERMUMETAL
RADIOMETAL
SPECIAL RADIOMETAL
RHOMETAL

High permeability Cobalt-Vanadium Iron Alloy with high saturation for lightweight generators, ultra-sonic generators and vibration test gear.

SUPERMENDUR
PERMENDUR

Rectangular hysteresis Loop Nickel-Iron Alloy for magnetic amplifiers and reactors.

HCR ALLOY

High-speed switching alloy for computors and magnetic amplifiers.

H.S. ALLOY

DUCTILE HARD MAGNETIC ALLOY

Cobalt-Iron-Vanadium Alloy.

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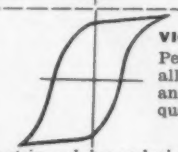

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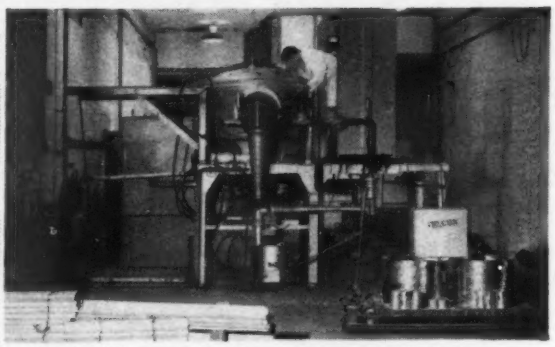

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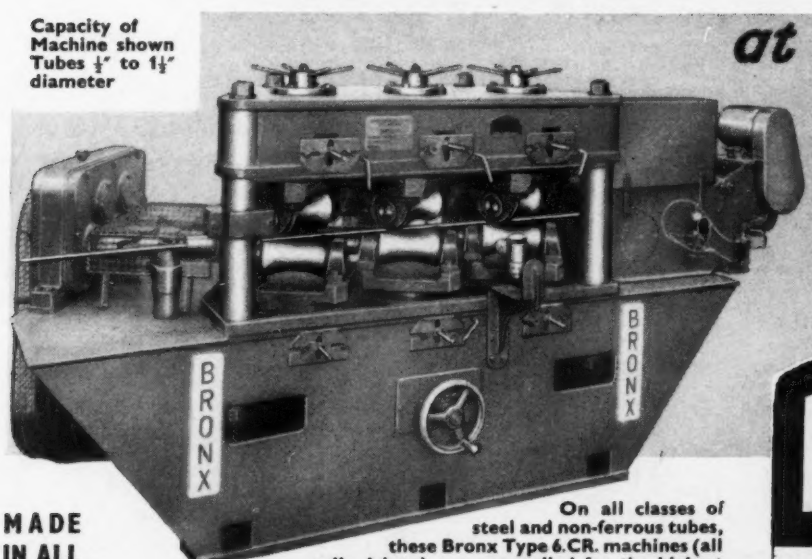

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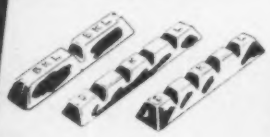

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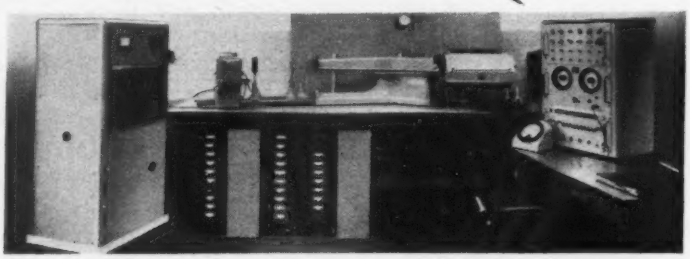

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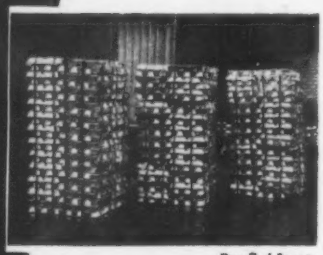

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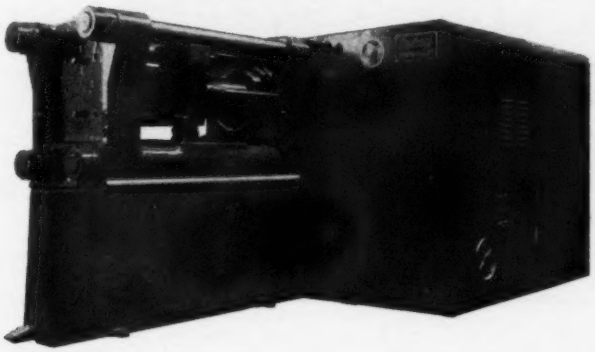

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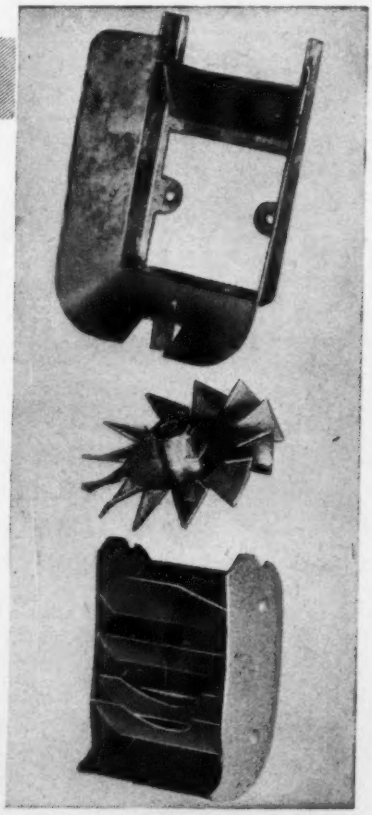

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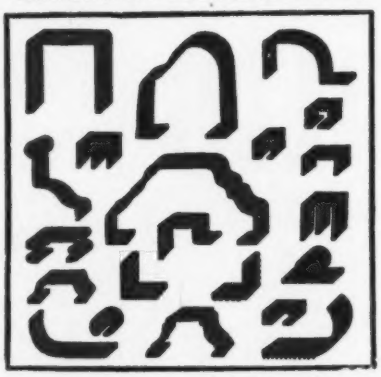

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INDEX TO ADVERTISEMENTS

	Page
Associated Lead Manufacturers Ltd.	2
Auxiliary Rolling Machinery Ltd.	*Inside front cover*
Batchelor, Robinson & Co. Ltd.	*Outside front cover*
B.K.L. Alloys Ltd.	20
Bond, Chas. H.	24
British Electrical Development Assoc.	9
British Furnaces Ltd.	6
Brock Metal Co. Ltd., The	13
Bronx Engineering Co. Ltd., The	19
Canning & Co. Ltd., W.	*Inside back cover*
City Casting & Metal Co. Ltd.	18
Cohen & Sons Ltd., George	20
Coley & Son (Hounslow) Ltd., R. J.	22
Consolidated Zinc Corporation (Sales) Ltd.	16
Coulthard, & Co. Ltd., Wm.	21
Delaney Gallay Ltd.	3
Eclipse Foundry & Engineering Co. (Dudley) Ltd.	10
Elton Levy & Co. Ltd.	18
Foundry Flux Ltd.	19
Frost Ltd., N. T.	24
Gas Council, The	*Outside back cover*
Gills Pressure Castings Ltd.	21
Hadfields Ltd.	1
Hall Foundries Ltd.	11
Hall Street Metal Rolling Co. Ltd.	20
Harris (B'ham) Ltd., F. W.	11
Heneage Metals Ltd.	17
Hilger & Watts Ltd.	11
Holroyd, John, & Co Ltd.	5
Ireland (Wolverhampton) Ltd., John	10
Jackson & Son Ltd., E. W.	*Inside back cover*
Midland Metallics Ltd.	10
Mitcham Smelters Ltd.	23
Monometer Manufacturing Co. Ltd.	23
Ormerod Ltd., R. E.	10
Peco Machinery Sales Ltd.	7
Platt Metals Ltd.	17
Pontifex & Sons Ltd., H.	14
St. Helens Smelting Co. Ltd.	24
Silvercrown Ltd.	*Inside back cover*
Sklenar Furnaces Ltd.	*Inside front cover*
Smith & Sons (Clerkenwell) Ltd., J.	4
Strebor Die-Casting Co. Ltd.	8
Telegraph Construction & Maintenance Co. Ltd.	18
Tranter Ltd., George E.	22
Westinghouse Brake & Signal Co. Ltd.	12
Western Diecasting Ltd.	10
West Yorkshire Foundries Ltd.	10
Wilkes Chemical Co. Ltd., Henry	*Inside back cover*
Williams Bros. & Piggott Ltd.	22
Young Ltd., T. W.	24

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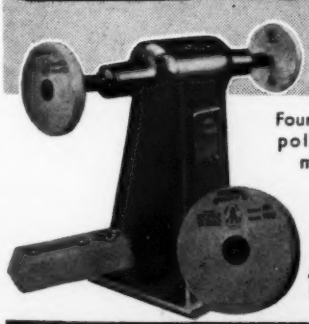

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